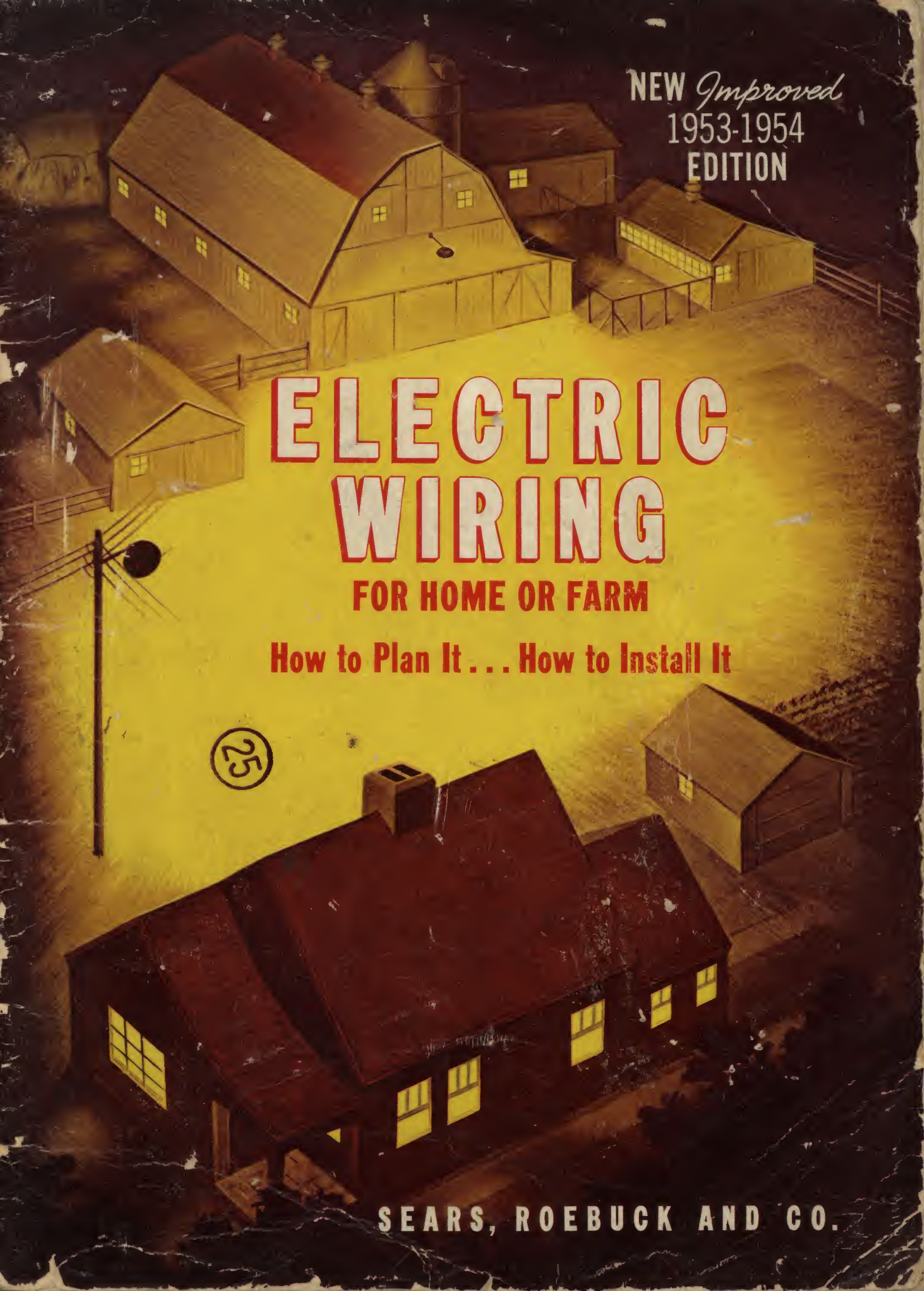
NEW *Improved*
1953-1954
EDITION

ELECTRIC WIRING

FOR HOME OR FARM

How to Plan It . . . How to Install It

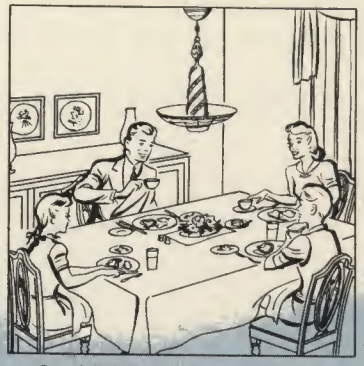
25



SEARS, ROEBUCK AND CO.

"Planned Wiring"

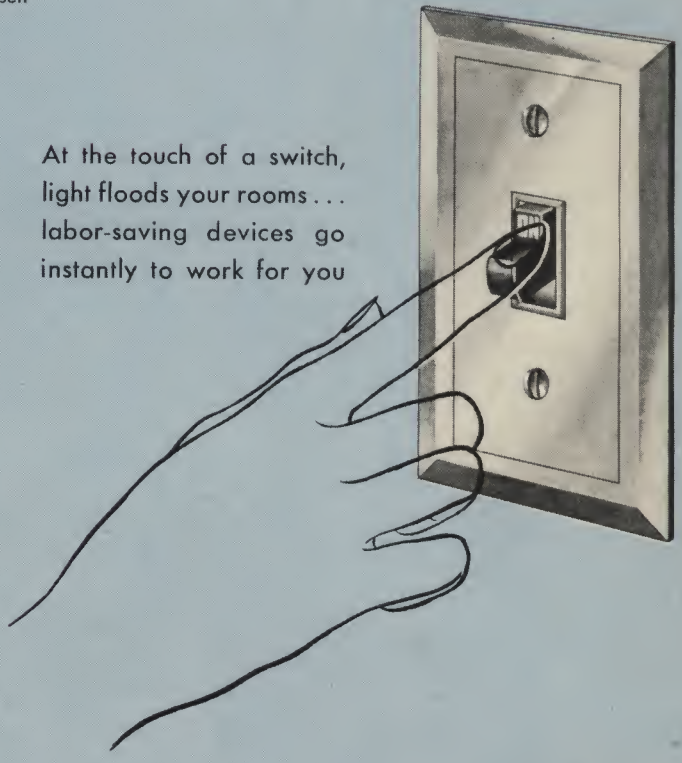
An electric range practically prepares meals for you by itself

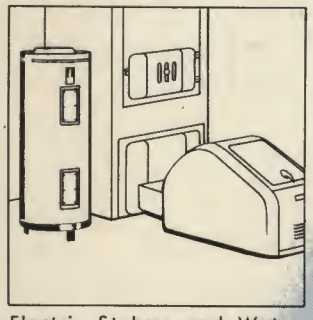


Good light saves eyesight, makes rooms beautiful and attractive

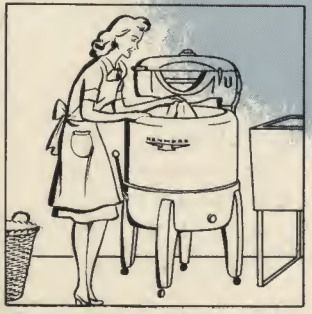
An electric refrigerator keeps food fresh and edible longer

At the touch of a switch, light floods your rooms . . . labor-saving devices go instantly to work for you





Electric Stokers and Water Heaters operate automatically



On washdays an electric washer saves time . . . reduces drudgery

Vacuum cleaners simplify and speed up house cleaning tasks

A portable heater provides instant heat wherever it is needed

for the up-to-date electrified home

With electricity you have more time to do many extra things around the house . . . more time for your family

Electrical living makes the home a more pleasant place in which to live. Tasks that once took hours to perform are now undertaken by time-saving, automatic servants. With the aid of electricity you have more time to spend with your family . . . time for hobbies and recreation.

To get the most from the multitude of electrical servants now waiting to serve you, you must plan ***an adequate system of wiring.*** This means that your home must be wired to accommodate all lighting and electrical appliances you now have as well as those you expect to install in the future. Think ahead . . . plan for the following:

Housework savers such as a vacuum cleaner; a range and dishwasher in the kitchen; washer, ironer and clothes dryer in the laundry.

Refrigerator and Food Freezer to keep foods fresh, healthful, and delicious; to eliminate canning. You'll eat better the whole year 'round.

Water Heater and Pump to provide a lavish supply of hot running water whenever you need it.

Bright anti-glare light in every room to eliminate eyestrain and make rooms cheerful.

Health and comfort appliances such as portable and built-in heaters to provide warmth on chilly days, a ventilating system, fans, electric blankets, heating pads, sunlamps and heat lamps.

Convenience appliances which cut housework in half—toaster, roaster, coffee-maker, mixer, waffle-iron, sandwich grill, and clock.

A Radio-Phonograph for news, music, entertainment.

To enjoy electrical living, ***be sure to plan ahead NOW!*** See that you have a large enough electrical system to meet your growing electrical needs. Plan for a sufficient number of branch circuits to carry full current to all appliances. Be sure you have plenty of convenience outlets so that lamps and appliances can be used where you want them.

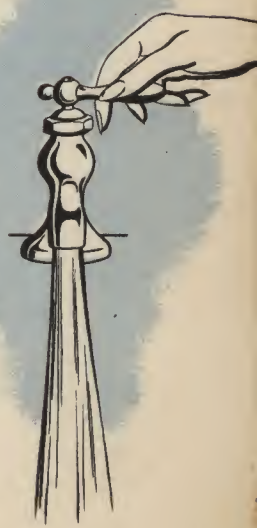
A few more dollars spent for your wiring system now will make it possible for you to enjoy all the electrical servants to be developed in the future . . . without costly rewiring expense.

Small appliances greatly add to your comfort and convenience

Entertainment for the whole family at the turn of a radio dial

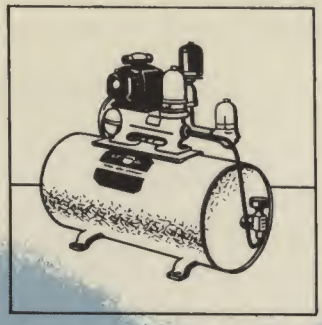
Running water the instant you want it with just a twist of the wrist

The convenience of running water at low cost is possible for those who live away from city water lines. Running water increases farm profits by saving you time, labor, and money. Plan for a large enough system so that you will have sufficient water for your home, cattle, poultry, and garden at all times.

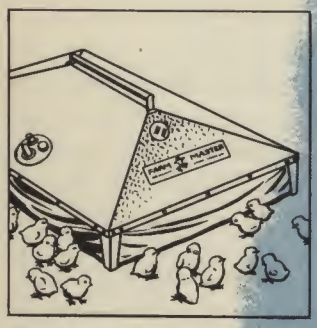


"Planned Wiring"

Electric milking machines cut milking time in half



All the water you want, hot or cold, at "city pressure"



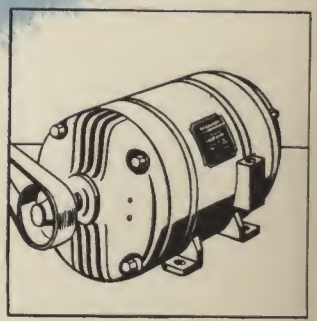
Brooder care is simplified by constant, controlled heat

A well-lighted, warm work-shop, properly equipped with good tools and an electric motor to furnish power for grinders and tools, is one of the most profitable farm investments you can make

Cream separators and churns save time, labor and money

An electric milk cooler pays for itself in a few months

You'll eat better and avoid waste with a food freezer



A portable electric motor drives grinder and tools

for the efficient electrified farm

Electricity is cheap . . . saves time and labor . . . does as much work for 10c as a man can do all day

Electrification on your farm is more than a dream . . . it is a reality thanks to your local REA Cooperative and the Utility Companies. Electricity can and will bring to American farms modern lighting, running water, powered equipment, scientific machinery, and conveniences that farmers have so long needed and deserved.

Electricity means higher profits, too. No matter what type of farm you own, the intelligent use of dependable Electric Servants will increase production . . . permit you to do more work in less time and at lower cost.

Hand labor costs money, even when you do the work yourself. It wastes your time, time that could be more profitably spent doing something else. Can you afford to spend your own time at hard drudgery jobs like shelling corn, pumping water, milking cows, or cutting wood when electricity does them for only a few pennies an hour?

Look ahead to the day when your farm will be run almost entirely by electricity and plan now for an adequate wiring system. Remember that the more electricity you use, the less it costs per kilowatt hour, because rate schedules are always based on a sliding scale. For example the table below indicates the average rates charged by the power supplier of a typical farm community. Note how the cost of power decreases as consumption increases.

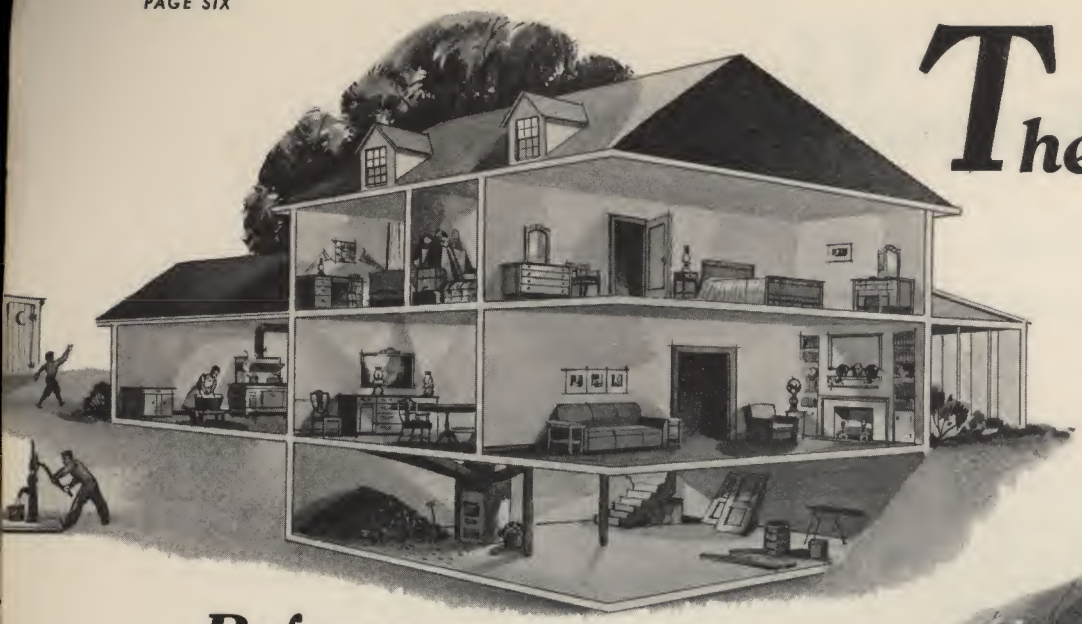
Current used per month	*Cost per kilowatt hr.*
First 35 kilowatt hours	$3.00 minimum bill
Next 45 kilowatt hours	4½ cents per kwh.
Next 120 kilowatt hours	2½ cents per kwh.
Over 200 kilowatt hours	2 cents per kwh.

Make your own equipment repairs with an electric grinder

Save time and labor with an electric automatically controlled Hammermill

Farmyard and building lighting stretches the working day of farm animals as well as farmers. You can do after-dark chores more easily and safely. Properly placed yard lights prevent accidents and discourage prowlers

The old way



Before

and

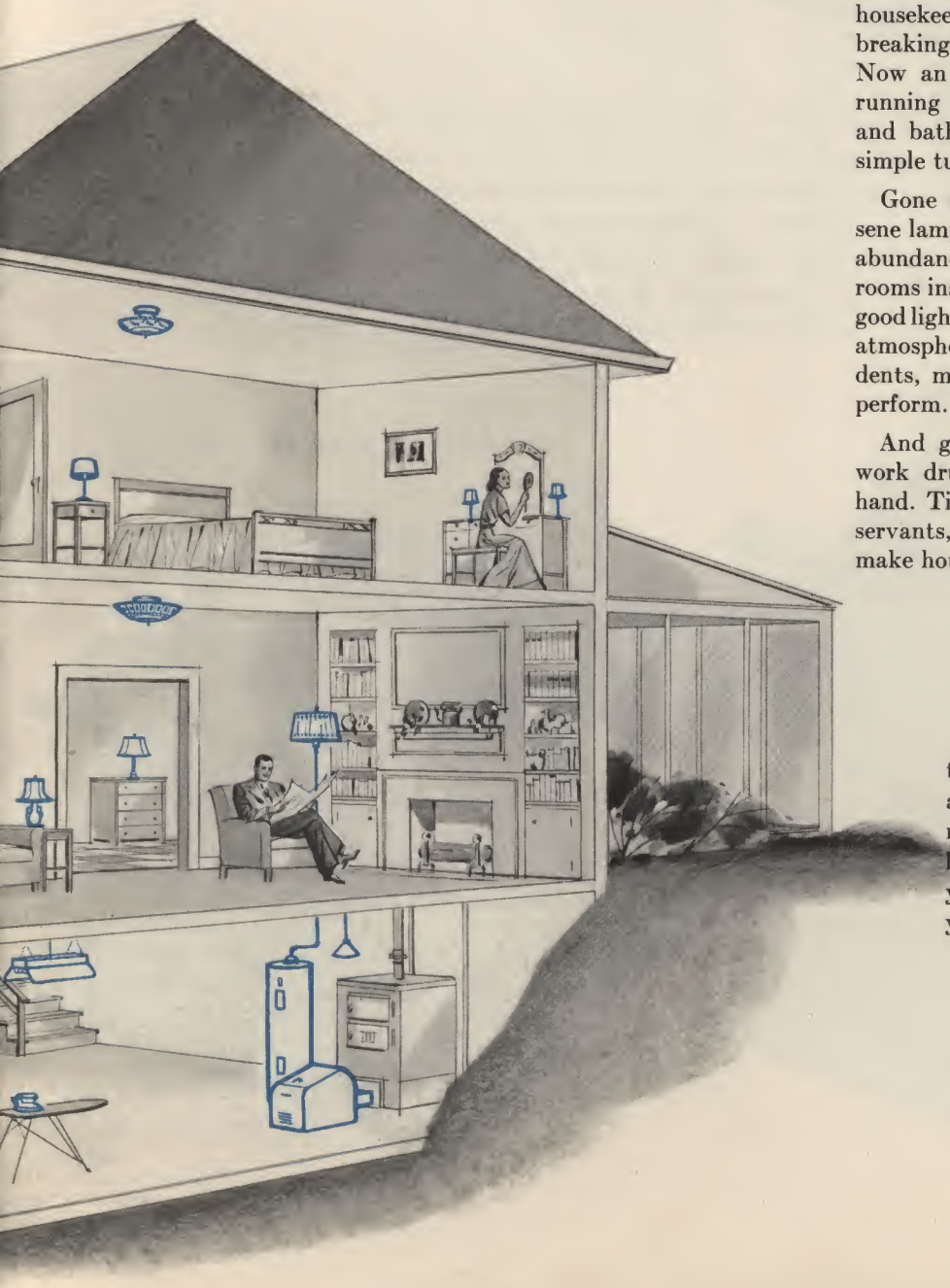
After

. . . and the modern Electric way

Better light to protect precious eyesight . . .

A houseful of time-saving, work-saving Electric Servants . . .

Plenty of running water at the turn of a valve . . .



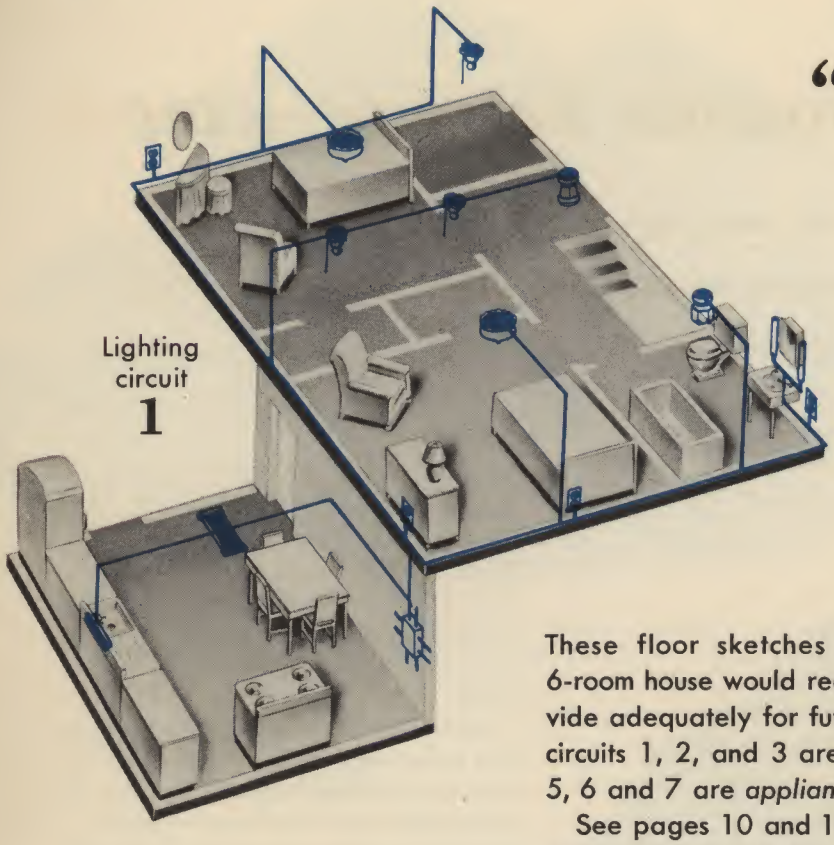
Gone are the days of dark, cold, cheerless homes and the drudgery and toil of housekeeping. The old-fashioned, back-breaking hand pump is a thing of the past. Now an electric water system supplies running water in the kitchen, laundry, and bath, whenever you want it, by a simple turn of the faucet.

Gone are the flickering, smelly kerosene lamps you used for illumination. An abundance of clean bright light fills your rooms instantly at the flip of a switch . . . good lighting that creates a warm, friendly atmosphere, prevents eyestrain and accidents, makes every home task easier to perform.

And gone is the never-ending housework drudgery of doing everything by hand. Time and energy-saving electrical servants, available for almost every job, make housekeeping much easier!

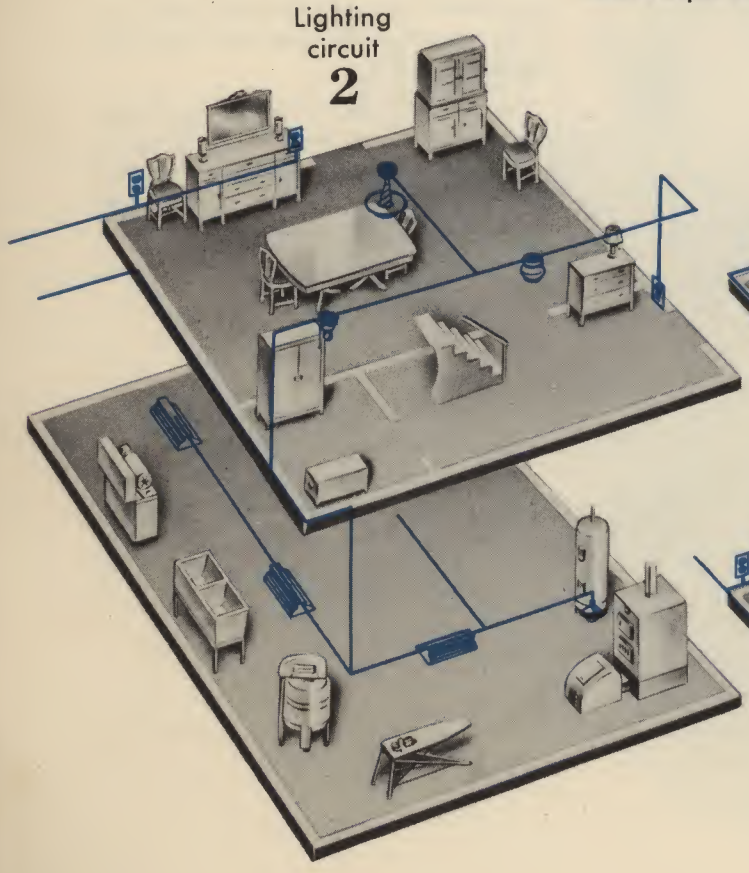
"Planned Wiring" means wiring that meets all your requirements at lowest cost to you. Start planning now. The following pages will help you decide how much wiring you need to get the most from your electrical system.

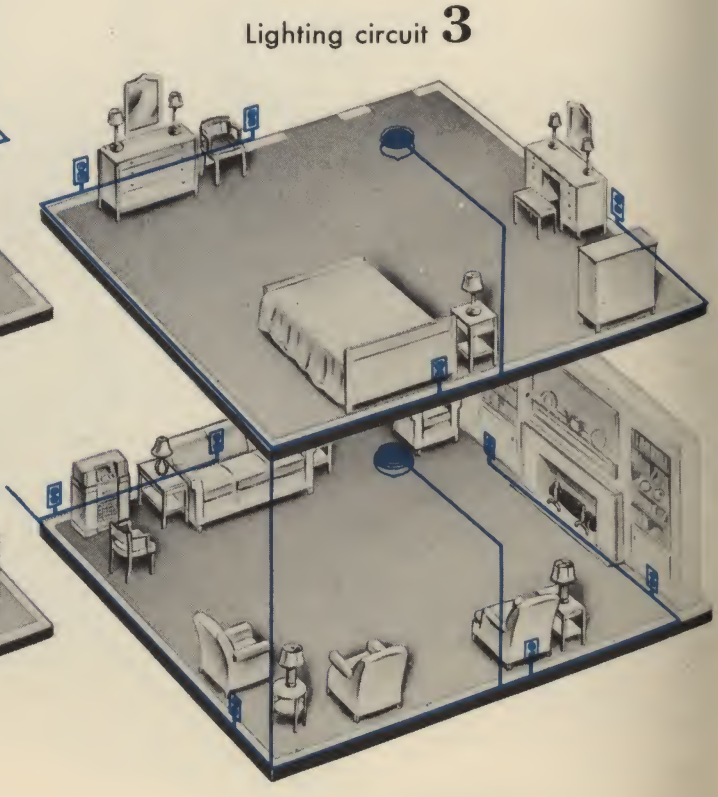
"Plan ahead"..



These floor sketches show why the average-size 6-room house would require at least 7 circuits to provide adequately for future loads. Note especially that circuits 1, 2, and 3 are *lighting circuits* and circuits 4, 5, 6 and 7 are *appliance circuits*.

See pages 10 and 11 for further information about code requirements for various types of circuits.





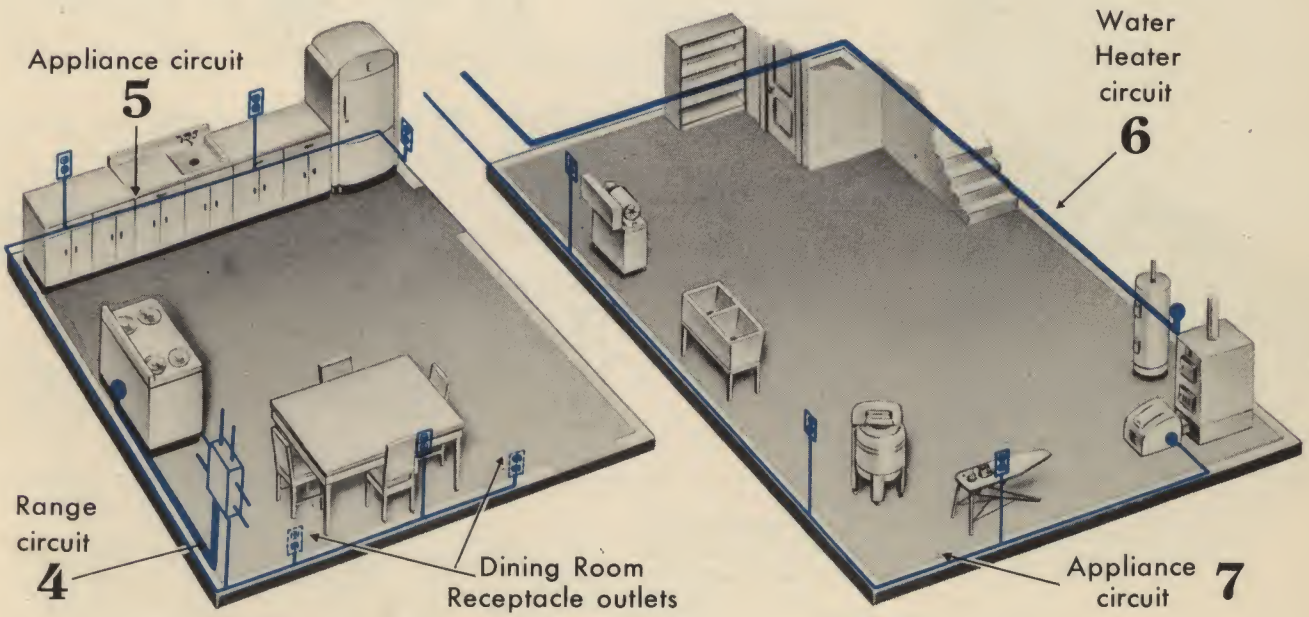
. . be sure to provide for future loads

Include in your wiring plans all the marvelous Electric Servants you hope to have by 1955

In building new homes or modernizing old ones, it is important to "wire ahead" for better living. Through short-sightedness and failure to provide sufficient wiring, many homes 10 years from now will be out-of-date because the wiring system will be inadequate to carry the current required by the numerous appliances of the future. Remember that the home of the future will be an Electric Home, that many new Electric Servants will soon be available to you . . . Servants such as Electric Dish Washers, Room Coolers, Food Freezer Units, and a host of others. Be sure your wiring is ready for them. For a few extra dollars spent now you may avoid costly rewiring later on.

Now is the time to plan. Think not only of the uses you intend to make of electricity immediately but also make a list of the appliances you hope to have in the future—then plan your wiring system accordingly. ***First,*** be sure to include a service entrance large enough to bring in all the electricity you will need. ***Second,*** be sure you have enough circuits to distribute the electrical load properly. ***Third,*** provide plenty of convenience outlets in the right locations.

Adequate wiring saves money in many ways: Motors run faster and cooler . . . lights burn brighter . . . appliances operate more efficiently when your home is wired to prevent overloads. See following pages for practical helps in deciding just how much wiring is adequate for your future needs.



Adequate wiring

1 Service Entrance capacity planned to carry future loads

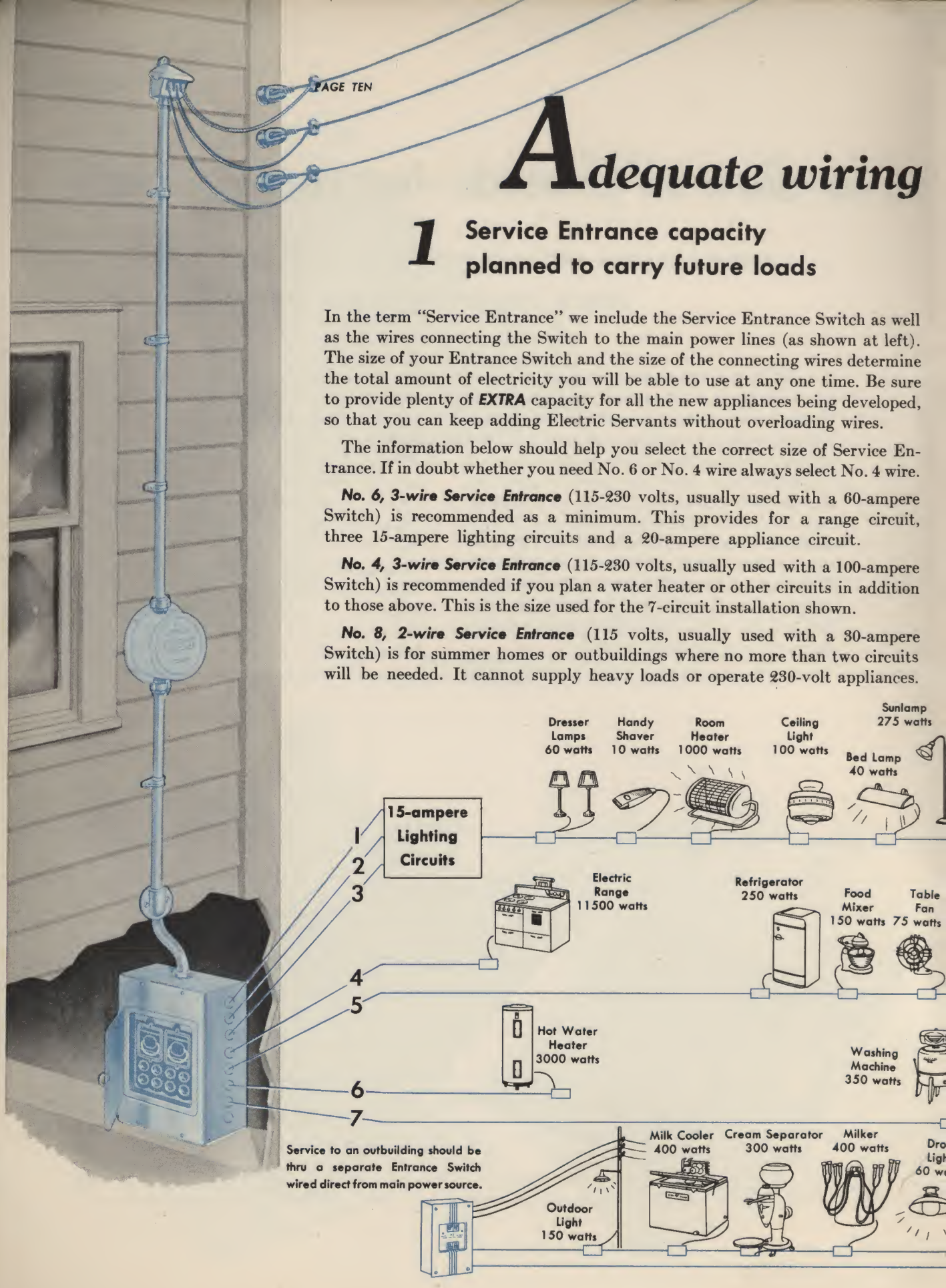
In the term "Service Entrance" we include the Service Entrance Switch as well as the wires connecting the Switch to the main power lines (as shown at left). The size of your Entrance Switch and the size of the connecting wires determine the total amount of electricity you will be able to use at any one time. Be sure to provide plenty of ***EXTRA*** capacity for all the new appliances being developed, so that you can keep adding Electric Servants without overloading wires.

The information below should help you select the correct size of Service Entrance. If in doubt whether you need No. 6 or No. 4 wire always select No. 4 wire.

No. 6, 3-wire Service Entrance (115-230 volts, usually used with a 60-ampere Switch) is recommended as a minimum. This provides for a range circuit, three 15-ampere lighting circuits and a 20-ampere appliance circuit.

No. 4, 3-wire Service Entrance (115-230 volts, usually used with a 100-ampere Switch) is recommended if you plan a water heater or other circuits in addition to those above. This is the size used for the 7-circuit installation shown.

No. 8, 2-wire Service Entrance (115 volts, usually used with a 30-ampere Switch) is for summer homes or outbuildings where no more than two circuits will be needed. It cannot supply heavy loads or operate 230-volt appliances.



depends on 2 main factors

2 Enough branch circuits to carry full power to all appliances

Divide lights and outlets into various branch circuits, as illustrated, so that when a short circuit or an overload occurs on one circuit the others will continue to operate. In planning the circuits, do so with the idea of distributing the electrical loads so that too many lights or appliances are not concentrated on one circuit at one time. Overloading a circuit reduces the efficiency of appliances, dims lights, blows out fuses.

Code Requirements: You must have at least one 20-ampere Appliance Circuit serving appliances for kitchen, laundry, and dining room and ***entirely independent of lighting fixtures.*** We recommend two such circuits; one for appliances in kitchen and one for laundry and basement.

A separate 15-ampere Lighting Circuit is also recommended ***for every 500 square feet*** of floor space in your home. Such circuits may also be used to power radios, fans, sunlamps, and other low-wattage appliances.

Note the 7 circuits illustrated. These represent about the minimum in "Planned Wiring" for the average size home. Even if you do not now have an electric range or water heater, you will probably want them in the future and it costs very little extra to provide for them in your original plans.

Recommended wire sizes

1, 2, 3 ***Lighting Circuits.*** While primarily lighting circuits, appliances such as fans and vacuum cleaners can also be plugged into them. No. 14, 2-wire cable may be used but No. 12 is recommended.

4 ***Range Circuit.*** No. 6, 3-wire cable, protected by two 50-ampere fuses.

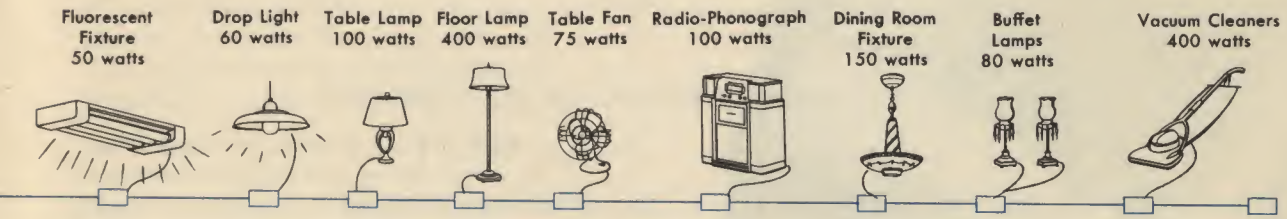
5 ***Kitchen Appliance Circuit.*** No. 10, 2-wire cable with 20-ampere fuse.

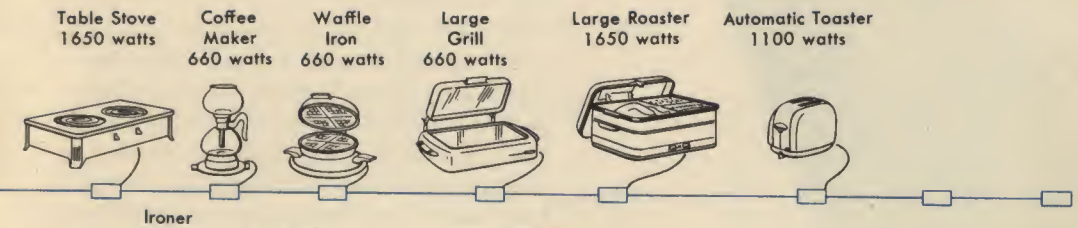
6 ***Water Heater Circuit.*** No. 12, 2-wire cable protected by 20-ampere fuse.

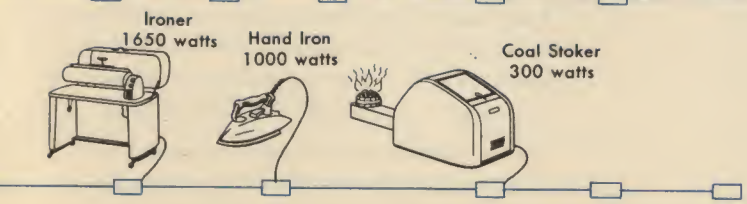
7 ***Laundry Appliance Circuit.*** No. 10, 2-wire cable with 20-ampere fuse.

Caution: Do not put all outlets on a floor on one circuit because if a fuse blows the whole floor will be in darkness. Instead, wire the outlets so that different parts of a floor will be connected to different circuits. ***For example:*** one half the first-floor and half the second-floor lighting can be wired to one circuit and the other half of each floor to another circuit.

Note: Some localities require all ceiling outlets on one circuit and all receptacles on another. Check local rules.

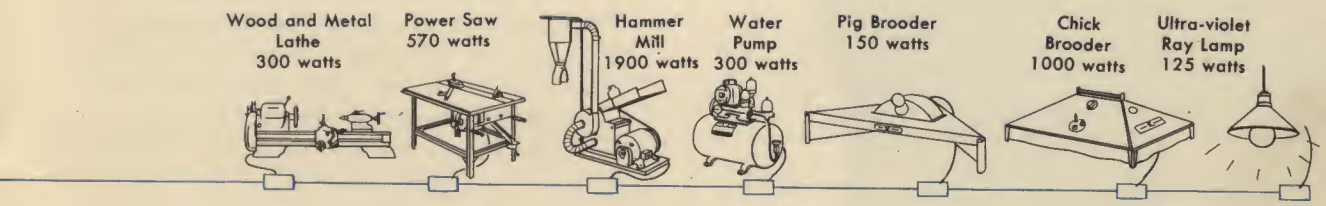






Notice:

Maximum carrying capacity of a 20-ampere Appliance Circuit is 2300 watts. Therefore, no combinations of appliances exceeding that wattage should be used *at any one time.*



Simplified instructions for a safe and sound installation

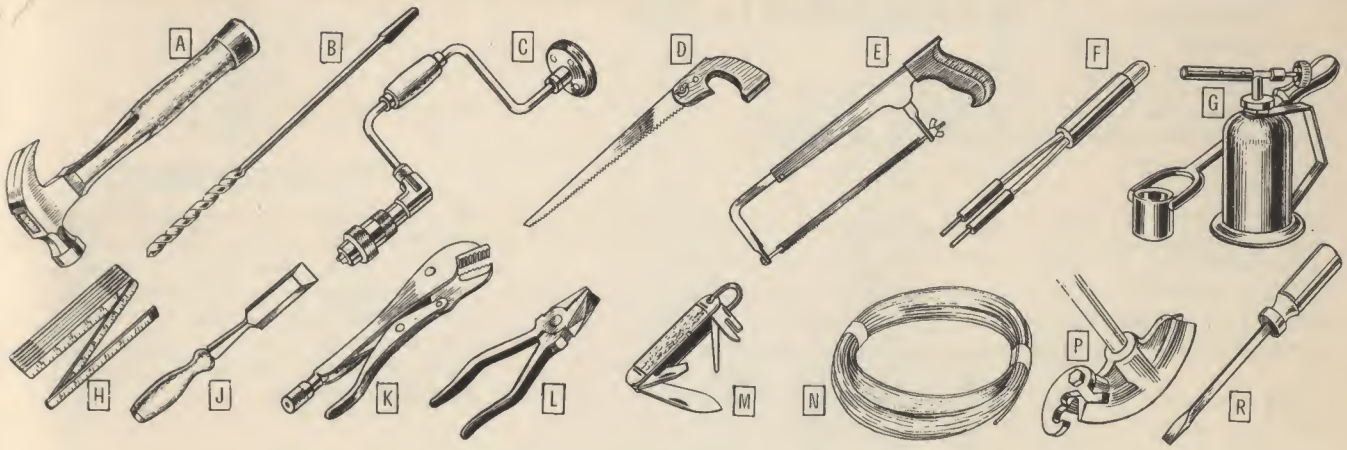
How to start

The first step (after you have prepared a plan showing exactly what kind of wiring installation you want) is to consult with your local REA Cooperative or Power Company. They will have much helpful information for you . . . advice as to what type and size of Service Entrance to use . . . whether a yardpole is required . . . how much of the installation the REA or Power Company will handle, etc. In most localities the REA or Power Company will make the installation as far as the meter.

Next, find out whether you need a wiring permit before starting the installation. Securing the permit (if it is needed) should not be difficult, provided you have mastered the information contained in this book and acquainted yourself with the regulations of the National Electric Code so that your installation will pass inspection for safety. The National Electric Code is a printed book of regulations specifying correct installation methods and the types of materials acceptable for various kinds of jobs. Your local REA or Power Company can furnish you with a copy.

Local Regulations. In some communities local regulations sometimes supersede the National Code regulations, so be sure that you know what these local regulations are. Also be sure that the materials you intend to use are approved by your local REA Cooperative or by your Power Company.

Tools you need to do the job



[A] **Hammer.** For driving staples, nails, fastening hangers.

[B] **⅝ inch Bit or Drill.** For boring wood or soft metal.

[C] **Bit Brace.** For use with drill, screwdriver, reamer.

[D] **Keyhole Saw.** For cutting circles and irregular shapes.

[E] **Hack Saw.** For cutting cable, plaster or laths.

[F] **Test Light** to trace circuits, test fuses and lines.

[G] **Blow Torch and Dip Cup** for soldering and splicing.

[H] **6-foot Folding Rule.** For measuring wire, openings.

[J] **Chisel.** For notching studs, joists, flooring and lath.

[K] **Lever-jaw Wrench.** Use as plier, lock wrench, pipe wrench.

[L] **Linesmen's Pliers.** For gripping locknuts, cutting wires.

[M] **Jack Knife** for cutting insulation, cleaning wires.

[N] **Fish Wire** for pulling wire thru wall and conduit.

[P] **Conduit Bender.** Approved means of bending conduit.

[R] **Screwdriver** to tighten screws, locknuts, straps.

Explanation of Standard Electrical Terms

A Volt is the unit used in measuring *electrical pressure* (like pounds in a water system).

An Ampere is the unit used in measuring electrical *rate of flow* (like gallons per minute in a water system).

A Watt is the unit which shows current drain with *both* voltage and amperage considered. For example:
1 Ampere at pressure of 1 Volt = 1 Watt.
1 Watt used for 1 Hour = 1 Watt Hour.
1000 Watt Hours = 1 Kilowatt Hour (Kwh.) which is the unit by which electricity is metered.

Horse-power—One HP equals 746 watts

Circuit—Two or more wires through which electricity flows out from the source of supply to one or more outlets, and then back.

Switch—A device for breaking the flow of current.

3-way Switch—A type used in pairs to control the same light from different points (see page 15).

Outlet—A device that permits tapping off electricity at convenient locations for lights or appliances.

Receptacle—A type of outlet to which electric cords can conveniently be plugged in.

Fuse—A safety device which breaks the flow of electricity whenever a circuit becomes overloaded.

Circuit-breaker—Performs the same function as a fuse in the "NO-FUZE" types of Entrance Switches.

Service Entrance Switch. The main panel (or fuse cabinet) through which electricity is brought into the building and then distributed to various branch circuits. Contains the main disconnect switch for the entire wiring system, as well as fuses or circuit-breakers.

"BX"—Common trade term for armored cable.

"Romex"—Term for non-metallic sheathed cable.

Conductors—Common trade term for electric wires.

Grounding—The connection of the electrical system to the earth, a precaution necessary to prevent damage from lightning and minimize danger from shocks.

"Hot" wires—The power-carrying wires (usually black or red) as distinguished from the "neutral" wires (usually white).

Insulation—A protective sheathing used over wires to prevent escape of electricity.

Polarizing—Identification of wires by color throughout the system to help assure that "hot" wires will be connected only to "hot" wires and that "neutral" wires run in a continuous uninterrupted connection back to the ground terminal.

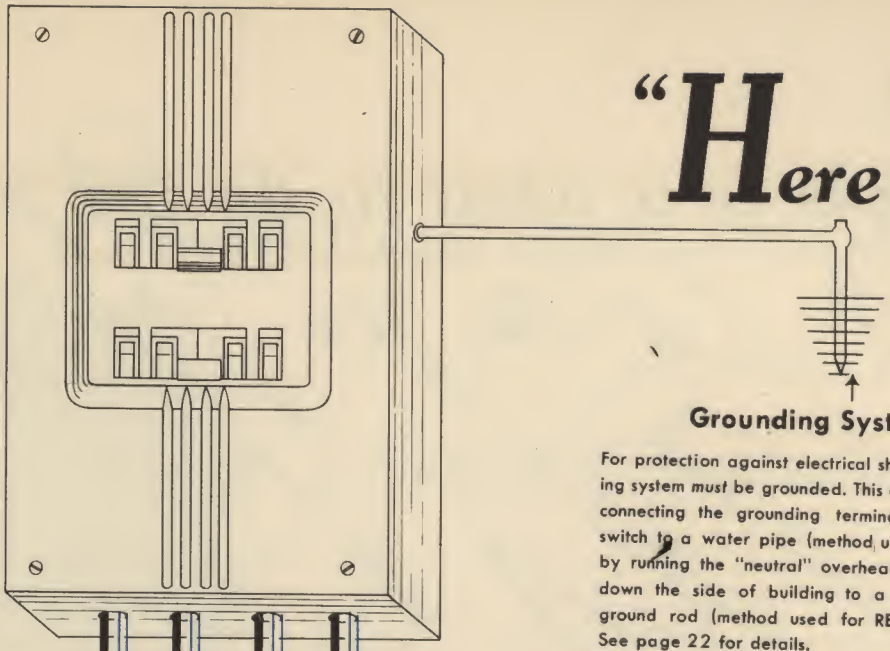
Alternating current—The type of power used in practically all farm and home wiring systems. Usually 60 cycles, but 25 and 50-cycle systems are used in a few localities.

Short circuit—An improper connection between "hot" wires or between a "hot" wire and a "neutral."

Underwriters' Laboratories—A nationally accepted organization which tests all types of wiring materials and devices to make certain that they meet minimum standards for safety and quality. Be sure to look for the Underwriters' tag or stamp on every piece of wiring material you buy. Don't take chances with inferior materials which have not been listed by Underwriters.

"Voltage drop"—A term used to indicate the voltage loss which occurs when wires are overloaded.

"Here is a



Service Entrance Switch →

This is the main distribution panel through which current flows to the various branch circuits. It is really the safety valve for the whole system, because it protects each individual circuit against danger of overload. See page 18 for types of Entrance Switch.

Grounding System

For protection against electrical shocks every wiring system *must* be grounded. This can be done by connecting the grounding terminal in entrance switch to a water pipe (method used in cities) or by running the "neutral" overhead wire directly down the side of building to a driven outside ground rod (method used for REA installation). See page 22 for details.

One complete circuit →

Illustration shows how one 2-wire circuit carries current from entrance switch to several light fixtures, outlets or junction boxes on the same line. Also shows the correct connections for both the white and black wires.

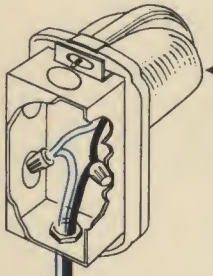
Branch Circuits

Each circuit has one white "neutral" wire and one or more current-carrying "hot" wires which are colored black or red. Wires are colored for easy identification, so that white wires will be connected only to white wires and the black or red "hot" wires only to "hot" wires.

Correct identification of the "neutral" and "hot" wires throughout the system is extremely important and is known as "Polarizing." Keep the following rules in mind when making installations.

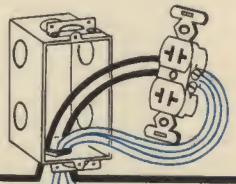
. . . In wiring convenience outlet receptacles the black or red wires must always be connected to the dark (brass-colored) terminal, the white wire to the light (Silver-colored) Terminal.

. . . In wiring *switches* the white wire must be run in a direct line from source to every outlet without interruption by a switch. Never connect a white "neutral" wire to a switch . . . the only exception to this rule occurs in certain wiring combinations to be shown later, where the white wire is used as a "hot" wire and *must be painted black.*



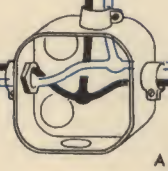
← Wall Bracket Fixture

For kitchen, bathroom, or over mantelpiece. Usually these are controlled by a separate switch at base of fixture. Easily installed in an ordinary switch box. No solder or tape needed —use solderless connectors as shown.



Receptacle Outlet

A handy tap from which current can be obtained by inserting a plug. Install plenty of outlets so that you can plug in all types of appliances without the use of long extension cords.



Junction Box

A device used to run wiring of a branch circuit in two or more directions. Simply splice white wires together and black wires together. Also sometimes used as a ceiling box for lights or as an outlet box for receptacles.

Basic Wiring System Simplified"

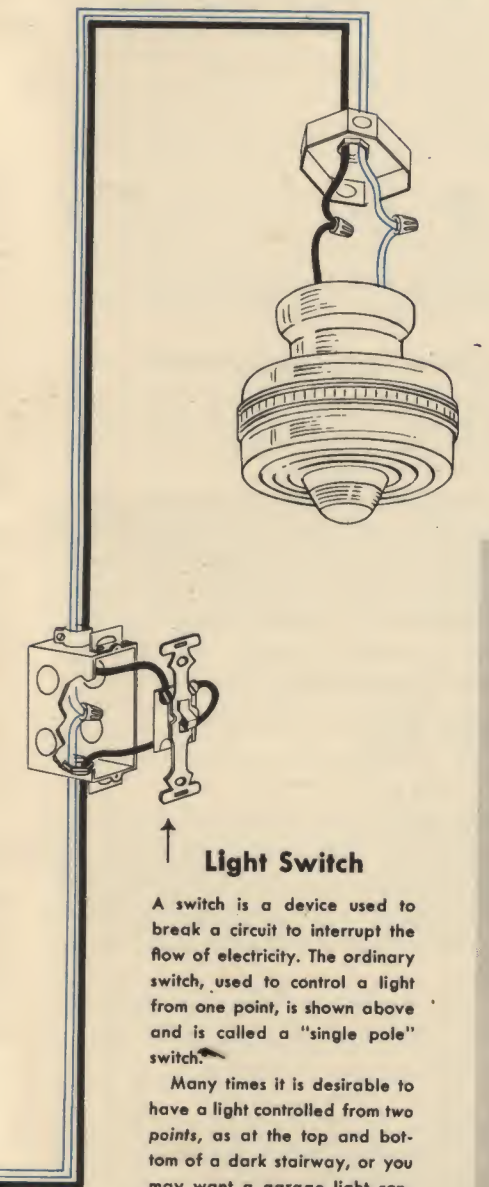
Shows the elementary principles to help you understand how a wiring system works

By mastering a few basic principles any handy man can install a wiring system that will perform safely and efficiently. The purpose of this book is to show you how to do it. Let's start with the illustrations on these two pages. They explain the fundamentals of wiring and the functions of various devices.

Note that an electrical system is much like a pressure water system . . . electricity flows from the power lines through the meter and into the entrance switch, which then distributes the electricity as needed to various circuits. For purposes of simplicity, we illustrate only one complete circuit, two lights and one outlet, but you may have any number of circuits, lights or outlets provided the service entrance is large enough.

Light Fixtures

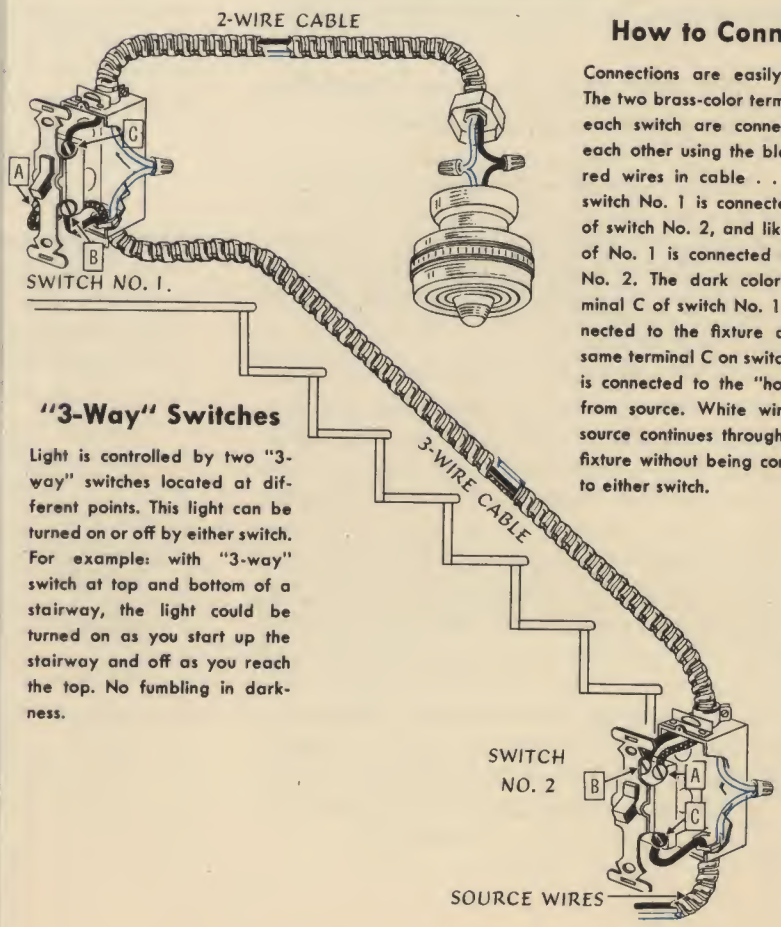
Fixtures come ready wired; all you do is connect outlet wires using solderless connectors as shown.



Light Switch

A switch is a device used to break a circuit to interrupt the flow of electricity. The ordinary switch, used to control a light from one point, is shown above and is called a "single pole" switch.

Many times it is desirable to have a light controlled from two *points*, as at the top and bottom of a dark stairway, or you may want a garage light controlled from both house and garage. For this purpose use two "3-way" switches. The method of wiring is shown at right.



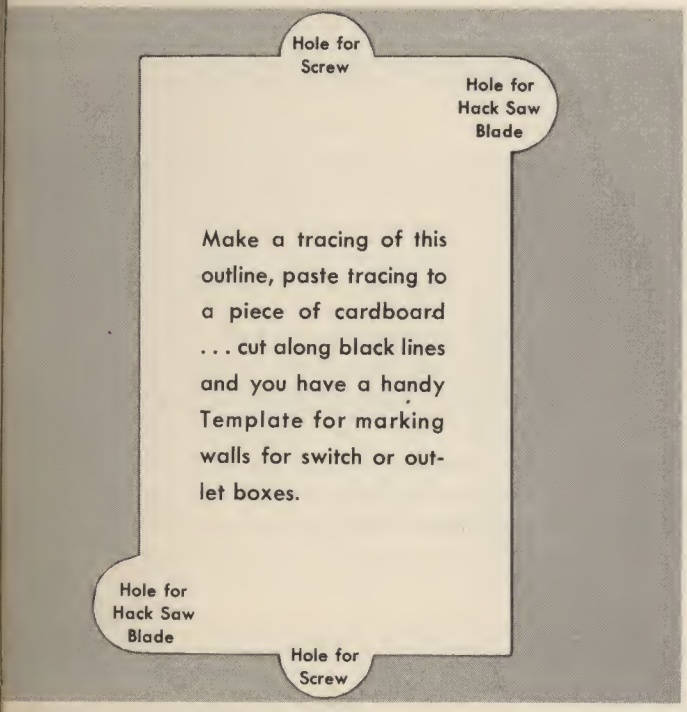
"3-Way" Switches

Light is controlled by two "3-way" switches located at different points. This light can be turned on or off by either switch. For example: with "3-way" switch at top and bottom of a stairway, the light could be turned on as you start up the stairway and off as you reach the top. No fumbling in darkness.

How to Connect

Connections are easily made. The two brass-color terminals of each switch are connected to each other using the black and red wires in cable . . . A of switch No. 1 is connected to A of switch No. 2, and likewise B of No. 1 is connected to B of No. 2. The dark colored terminal C of switch No. 1 is connected to the fixture and the same terminal C on switch No. 2 is connected to the "hot" wire from source. White wire from source continues through to the fixture without being connected to either switch.

Important facts for you to know



Take time now to make this Template

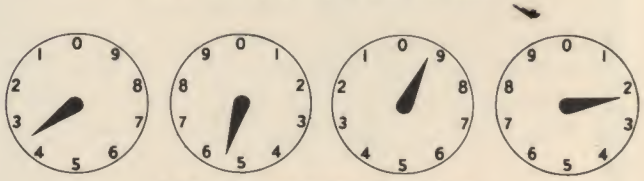
You will find it a handy Work-Saver

Where you have several metal boxes to install we suggest you use this time-and-work-saving Template. By using a Template you can saw through plaster and lath at the same time. There is less chance of large unsightly cracks on wall, less chance of damaging wallpaper.

All you need to do is place Template against wall where you wish to install the metal box. Outline with a soft pencil the form of the Template. Drill four holes, the two holes at top and the two holes below as outlined on Template. The center holes at top and bottom are to allow for screws used to fasten receptacle or switch to box. The two holes at sides allow clearance for screws that protrude over the box, and also provide opening for a hack saw blade.

How to cut. Start to cut along outside edge of the pencil line. Note that you cut plaster and lath at the same time. When complete opening is made, test the box and you'll find that you have a snug even fit. We recommend metal box supports to mount boxes. (Turn to page 31 for details).

Meter reading at beginning of the month



Meter reading at end of the month

How to Read an Electric Meter

Your electric meter has four dials that look like clocks. Each dial has a hand. Note that two dials read clockwise and two read counter-clock-wise.

Write down the number that the hand ***has just passed*** on each of the dials in the top row. Reading on dials is 3456 (KWH) Kilowatt hours. Let's assume the above figures represent the reading at beginning of month. Suppose at end of month the readings appear on dials in lower row. Reading as before, we obtain 3592 (KWH) Kilowatt hours. The difference is as follows:

This month's reading 3592
Last month's reading 3456
Kilowatt hours used in month . . . 136

How to figure current cost of each Appliance. The plate on every appliance shows its Amperage or Wattage. If amperage is given, it is easy to convert the figure into watts. Figure one ampere as equaling 115 watts. Thus a 10 ampere iron consumes 1150 watts. (10 amps. x 115 watts = 1150 watts).

Once you know the wattage of any appliance you can figure current cost per hour from table below.

Cost per hour to operate small appliances

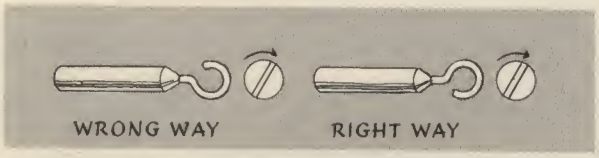
Wattage consumed by common household Appliances	*If rate is 3c per KWH*	*If rate is 4c per KWH*	*If rate is 5c per KWH*	*If rate is 6c per KWH*
100 watts	10 hrs. for only 3c	7½ hrs. for only 3c	6 hrs. for only 3c	5 hrs. for only 3c
300 watts	3 hrs. for only 2.7c	2½ hrs. for only 3c	2 hrs. for only 3c	1⅔ hrs. for only 3c
500 watts	2 hrs. for only 3c	1 hr. for only 2c	1 1/5 hrs. for only 3c	1 hr. for only 3c
700 watts	1.4 hrs. for only 3c	1.1 hrs. for only 3c	1 hr. for only 3.5c	1 hr. for only 4.2c
900 watts	1.1 hrs. for only 3c	1 hr. for only 3.6c	1 hr. for only 4.5c	1 hr. for only 5.4c
1000 watts	1 hr. for only 3c	1 hr. for only 4c	1 hr. for only 5c	1 hr. for only 6c

Cutting, splicing, and connecting wire

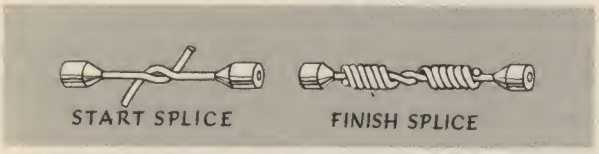
First step in good electric wiring is to know the right and wrong way to make your wire connections

Joining the ends of two separate wires together is known as a "splice." Joining a wire at right angles to a continuous wire is called a "tap." To make splices and taps as strong as a continuous piece of wire, the job must be done carefully and thoroughly . . . otherwise trouble will result. In joining two or more wires a good connection must meet two requirements: 1. Wires must be bright and clean when brought together. 2. Connection must be tight, well fastened (usually with solder) and covered with tape so that it is as well insulated as it was before original insulation was removed.

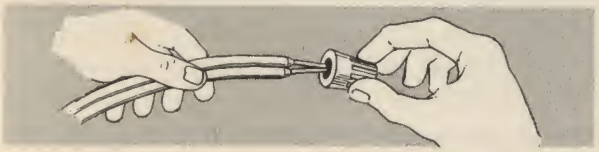
Cutting wire. Remove insulation by cutting at a slant—as in sharpening a pencil. Expose ½ inch of copper conductor. Remove all parts of insulation, but not tin coating, which makes soldering easy.



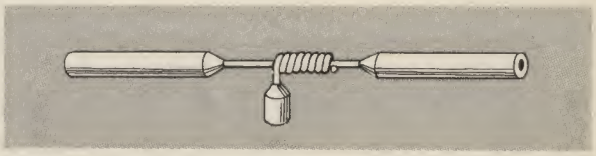
Connections at screw terminals. Bend end of metal wire into a loop to fit around the screw. Be sure to attach loop in direction in which screw turns when tightened as illustrated above.



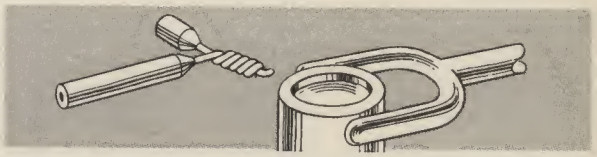
Splicing wires together. Remove about 3 inches of insulation from each wire and cross wires about 1 inch from insulation; make 6 to 8 turns using fingers, and pliers.



Solderless connectors eliminate the need for soldering joints. Made of insulating material so wires need not be taped—short circuits cannot occur. Simply screw the connector over wires as shown.

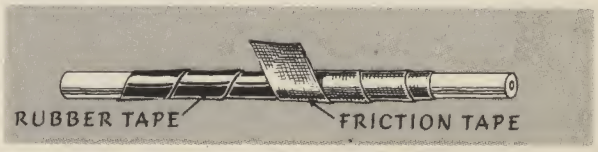


Tap splices. For connecting the end of one wire at a point on a continuous wire. Use only if there is no pull on tapped wire. Bare and clean the tap wire, then wrap around continuous wire. Solder and tape.



Dipping wires. Except where solderless connectors can be used, all splices and taps must be soldered. A soldering dipper is convenient for pigtail joints. Apply paste and dip wires into soldering pot.

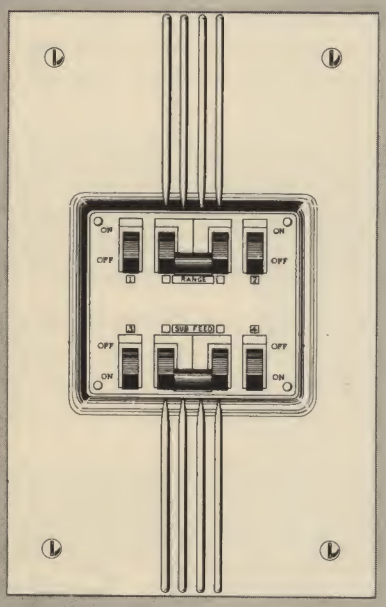
Applying solder. So solder will flow easier, first coat wires with electrical soldering paste. With soldering iron heat wires enough for solder to melt into every crevice when touched to them.



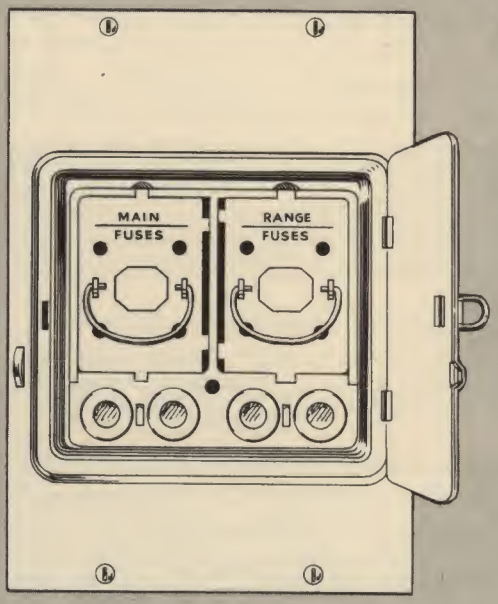
Taping. After wires are soldered they must be insulated. First, wrap joints with rubber tape, then cover with friction tape. If wires are not rubber covered, apply only layers of friction tape.

PART I

Providing an adequate



A "No-Fuze" type switch



B Fuse type switch

Types of entrance switches

The service entrance switch provides a current shutoff for emergencies or for safety in making changes and repairing wires . . . it also provides fuse protection for all branch circuits.

Size of entrance switch (30, 60, 100-amperes or over) depends on the amount of electricity you will use at any one time. A 60-ampere switch will accommodate a range and water heater and is the smallest size allowed by many power companies and local codes. See your power company or REA Cooperative. They will help determine the size you should use. Two types of service entrance switches are available:

A ***"No-Fuze" circuit-breaker type*** . . . a modern device which eliminates fuses. If circuit is overloaded or shorted, Circuit-breaker automatically stops flow of current. By flicking toggle handle to "On," after fault is corrected, circuit is ready to operate as before. Nothing is exposed—making it shockproof. Available in flush-mounted or surface types.

B ***Fuse type.*** The most common and least expensive type switch. Fuses are inside a steel box. 15-ampere plug-type fuses are used to protect lighting circuits and 20-ampere fuses to protect appliance circuits. Cartridge fuses protect circuits carrying more than 30 amperes, such as the range and heater circuits or 230-volt motor circuits. Pulling out cartridge fuse holder disconnects the circuit.

Important Note: A fuse is a safety valve . . . it protects wires and appliances against damage from overload. Never, under any circumstances, make the mistake of using fuses which are rated higher than the ampere capacity of the circuit they are to protect.

service entrance

By service entrance we mean all wiring connecting the power lines to your service entrance switch. Wires are attached to the power lines and then brought through a service entrance head down through the meter to the service entrance switch as illustrated. This is the most important part of your wiring system because the amount of electricity available to you depends entirely on the size and capacity of your service entrance and future needs should be anticipated. If the service entrance wires are too light or the entrance switch too small you will not be able to get enough electricity for efficient operation of electric motors, large fans, heaters or other high-wattage appliances. See recommendations on page 10 as to size of wire and size of entrance switch.

The Power Company or your REA Cooperative will usually supply the meter and frequently will furnish and install all wiring leading into the meter. Wiring beyond the meter is your responsibility. The trend today is to have meter located outside your house or on a Pole in your yard.

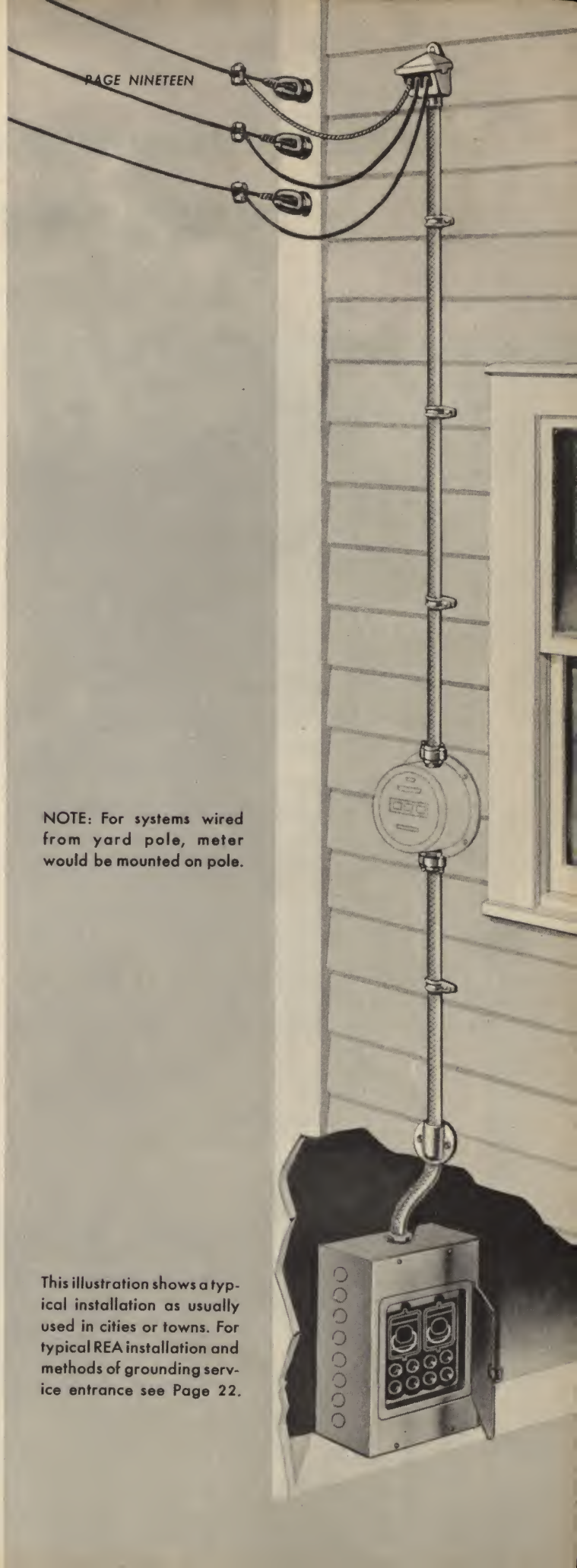
Where to locate the service entrance. The power company or REA Cooperative will decide where the service entrance should enter your buildings. If possible locate the service entrance switch near those rooms where the largest amount of current will be needed (usually the kitchen). Wires should be run as directly as possible from service entrance head down the wall to meter and then to the service entrance switch.

Service entrance installations may be made in either of two ways: ***1. with service entrance cable, 2. with rigid or thin-wall conduit.*** The materials you use depend upon state or local requirements, so consult your power company or REA Cooperative.

. . . ***Service entrance cable*** (armored or unarmored depending on locality) is the material most frequently used. Its advantages are low material cost and low installation cost. It can be installed around corners where conduit might be difficult to handle.

. . . ***Conduit installations*** are made by running insulated wires through the conduit, which is steel pipe fastened by couplings. (Comes in 10-foot lengths).

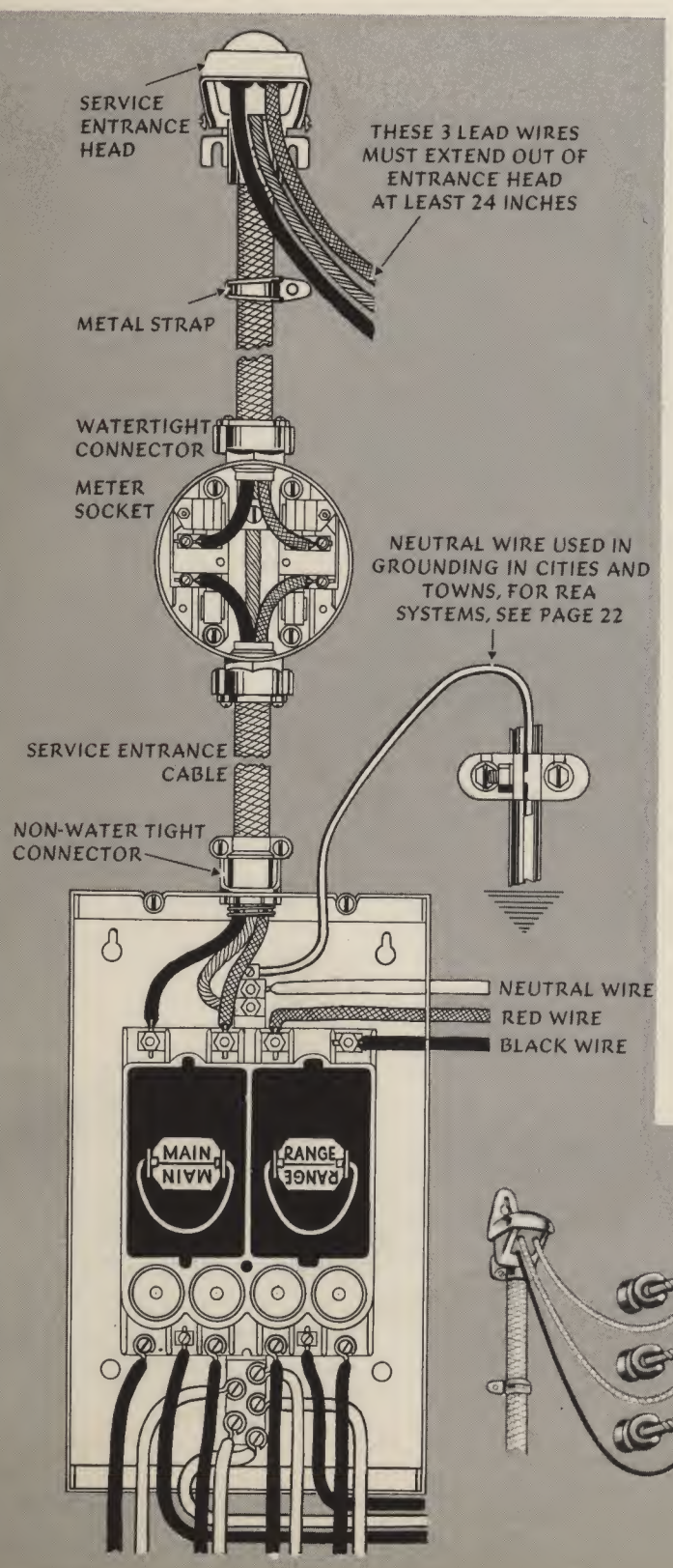
See following pages for methods of installation.



NOTE: For systems wired from yard pole, meter would be mounted on pole.

This illustration shows a typical installation as usually used in cities or towns. For typical REA installation and methods of grounding service entrance see Page 22.

Service entrance using service entrance cable



Take care that you select a large enough Service Entrance Cable to provide for all the light and appliances you need now and in the future. See page 10 to determine the size of cable to use.

How to install: A service entrance head is attached to building at least 10 feet above ground. The end of the entrance cable is stripped of its outer cover so that lead wires can be extended through Service Entrance Head ***at least 24 inches*** as shown. This allows plenty of length for connecting to the incoming power lines. Power lines are attached to buildings with service insulators located high enough to provide clearance for loaded wagons or farm trucks.

Anchor cable every 4 feet with metal rustproof straps. To hold cable in meter socket, use two watertight connectors—one where cable enters meter, and one at bottom where cable leaves meter. Cable is run down wall to hole drilled through side of building and connected to Service Entrance Switch. Switch should be located within one foot of where cable passes through wall. Use a sill plate to protect cable where it enters building.

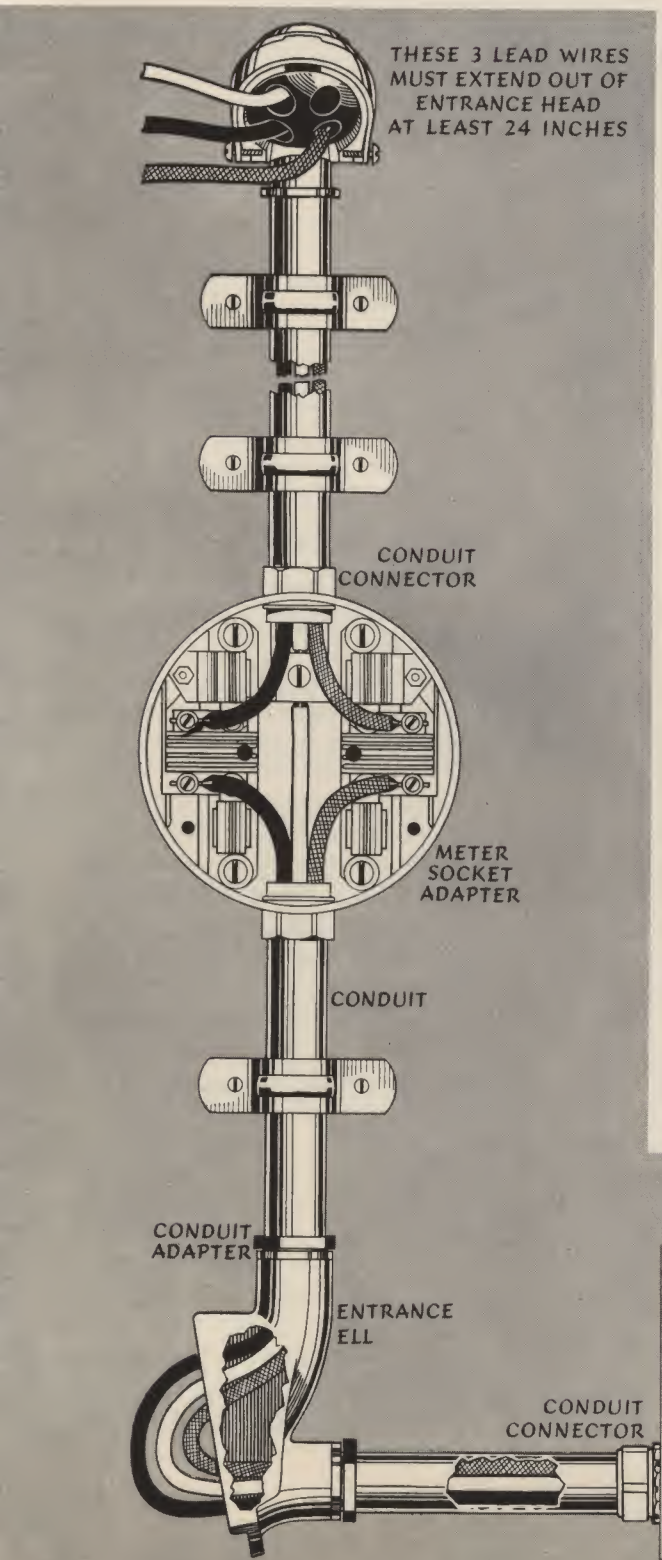
Connections to entrance switch. Black Wire of the Service Entrance Cable is connected to left hand terminal of 60-ampere main disconnect and red wire to right hand terminal. 3rd or bare neutral wire is attached to neutral bar which is used for grounding by connecting it with bare wire to an underground water pipe system (as shown). See page 22 for additional grounding instructions.

Note: Bare neutral 3rd wire of the service entrance cable consists of several uninsulated wires spirally wound around the two insulated wires. Just twist together to form the 3rd or neutral wire.

How to Connect Wires from Entrance Head to Overhead Wires

"A new rule of the National Electric Code requires that the service Entrance Head should be installed above the top insulator of incoming power wires. Drip loops shall be formed on individual Conductors. This will prevent water from entering the service entrance system."

Service entrance using steel conduit



For a 2-wire service entrance use one black and one white wire inside the conduit. For 3-wire service entrance use one black, one red, and one white wire inside the conduit. See page 10 to determine the recommended size of wires to use. Then choose conduit sizes as follows:

Use ¾-inch conduit for three number 8 wires.

Use 1¼-inch conduit for three number 4 or three number 6 wires for runs not exceeding 50 feet.

Installation: A service entrance head is attached to building at least 10 feet above the ground and conduit is then connected as shown in illustration at left. Use a metal strap every four feet to fasten conduit to building. Connect to meter with conduit connectors. To turn conduit into the building use an entrance ell. Ell has two threaded openings corresponding to conduit size with which it is used. Into the threaded opening at top of ell fasten conduit with an adapter. Into the lower opening fasten another piece of conduit to run through side of house. Connector (locknut with bushing) is used to attach conduit to entrance switch.

Inserting Wires: After conduit is installed, wires are pushed up the conduit through the meter hub into and out of the service entrance head, extending each wire ***at least 24 inches*** to allow plenty of length for connecting to power lines. Then wires are brought down from meter through conduit to the entrance ell. Ell cover can be removed and wires pulled all the way through to the entrance switch.

Connections to service entrance switch are the same as described and illustrated on opposite page, except that for conduit ***a white covered insulated wire*** should be used as the neutral or grounded wire.

CONNECTIONS TO ENTRANCE SWITCH ARE SAME AS SHOWN ON OPPOSITE PAGE

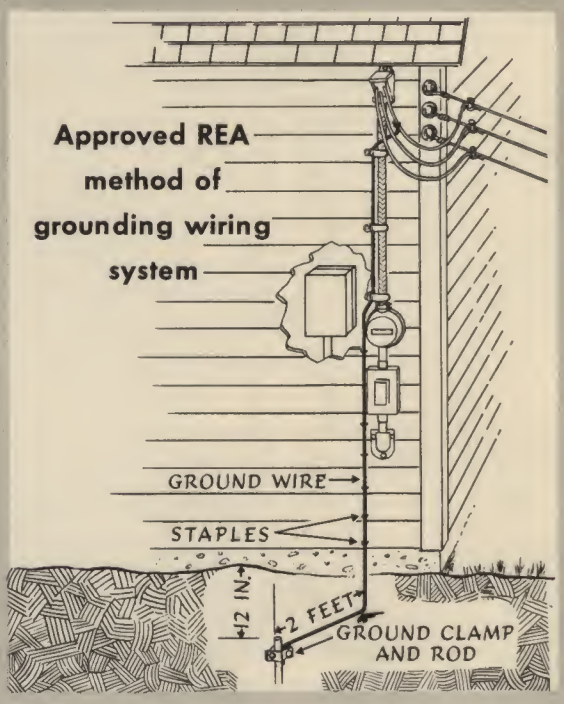
"Grounding the service entrance"

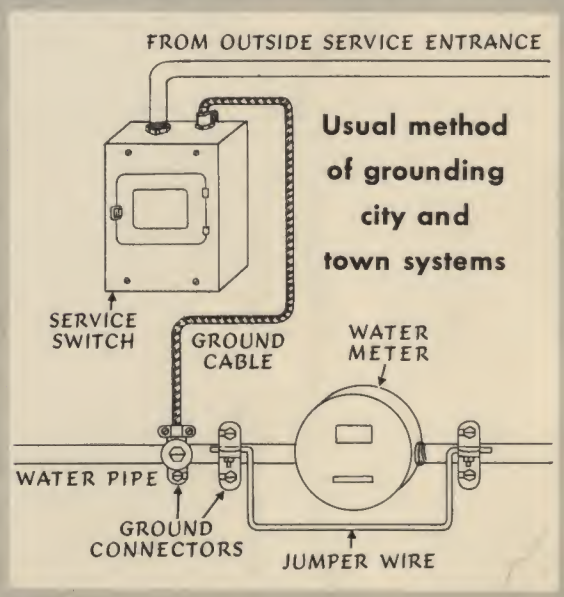
An electrical ground is ***any conductor that connects directly or through other conductors to the earth.*** The "neutral" wire of all alternating current systems must be grounded. Metal raceways, the enclosure for conductors, and the exposed frames of all fixed electrical equipment must be grounded. The grounding of the neutral conductor assures that this conductor will always be at ground potential, and the effect of high potentials or lightning strokes will be reduced. The grounding of metal enclosures and frames of equipment prevents shocks when exposed metal is accidentally livened. The National Electric Code covering grounds is strict and must be complied with. See Power Co. or REA for details.

Wire used for grounding. Normally you will not need a heavier wire than a No. 6 or No. 4 copper ground wire. This wire is heavy enough to be exposed, provided that the wire is free from danger of mechanical injury. If No. 8 ground wire is used it must be of the armored type or bare wire enclosed in conduit. Check REA or your Power Co.

Ground Rod Installation for a Farm. Approved REA Method is shown. Ground wire does not go through Entrance Switch but is tapped off the neutral overhead wire and brought down the side of the house or yardpole to a driven ground rod. You use a copper ground rod at least ½-inch in diameter or a ***galvanized*** iron or steel pipe at least ¾-inch in diameter. Ground rod must be at least 8 feet long, must be located at least 2 feet from any building and must be driven into the earth so that the top of the rod will be at least 12 inches under surface of earth. Ground wire is then attached to rod by a ground clamp which holds it in contact with metal. (See illustration for other details).

Ground Installation for City Systems. The ground wire is run from the "neutral" bar of the Service Entrance Switch to the cold water pipe of the water system. Wires should be attached securely to pipe by means of a ground connector. If possible, make connections to the water pipe on the street side of water meter. Otherwise connect to any point on pipe but be sure to install a jumper around the water meter by using two ground connectors and a piece of grounding wire, as shown at right.





PART 2

Types of indoor wiring

There are four principal approved types now in general use for indoor wiring: [1] Non-Metallic Sheathed Cable or Romex, [2] Flexible armored cable or "BX", [3] Rigid or thin-wall conduit (electrical metallic tubing) enclosing insulated indoor wire, and [4] "Knob and tube" wiring using insulated indoor wire. Selection of any type of wiring depends on the regulations set up by local authorities, and the type of structure that is to be wired. For some localities, as in large cities, only conduit or armored cable is used, while in some farm communities, all four types may be acceptable. Your REA Cooperative or Power Company will advise you.

1 ***Non-metallic sheathed cable*** (the type most often used in farm wiring) is especially recommended for barns, cellars, basements, outbuildings, and other damp locations; also used in many localities for home wiring. It can be used either for surface or concealed work, but may not be used out-of-doors, underground, or in masonry. Consists of two or more insulated copper wires covered with tough braided outer jacket to resist moisture, fire and acid vapors. Simple to install, it can be attached to floor or wall surfaces, is easily pulled through partitions or floor joists. Even though the cost of material is more than for "knob and tube" wiring, the ease of installing makes the finished system very inexpensive. Turn to page 25 for method of installation.

2 ***Flexible armored cable*** is recommended for indoor use in dry locations, particularly for home wiring. Use it either for exposed runs on wall and ceiling surfaces, or for concealed work runs in the hollow spaces of wall, floors, and ceilings. (Do not use it out-of-doors or in damp indoor locations, or underground.) Consists of two or more insulated wires encased in heavy galvanized steel protective cover. Armored cable is easy to install, is acceptable in almost all localities, and gives wires ample protection against mechanical injury. May be embedded in plaster finish of walls or ceilings that are not excessively damp. Because of its flexibility it is frequently used for extensions of conduit systems already installed. See page 24 for method of installation.

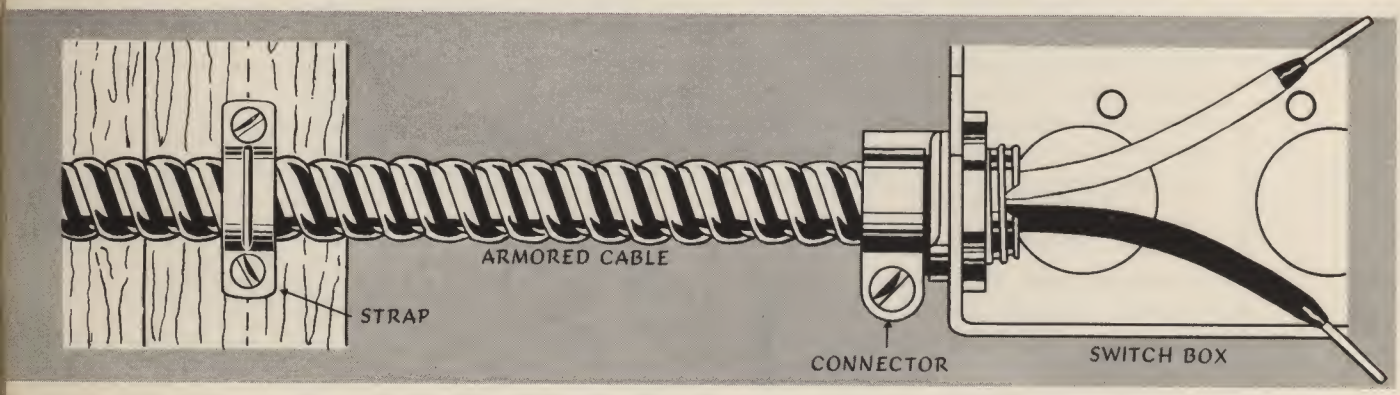
3 ***Thin-wall or rigid conduit*** is the most expensive and most generally accepted form of wiring for ordinary conditions, because it provides greater protection to the wires . . . also because it grounds the entire system, an extra safety feature. In many urban communities conduit is the required method of wiring.

Conduit can be used indoors or out, in either wet or dry locations, and in masonry, fills or concrete (except cinder concrete). It is generally used in "new" work only, because the installation of conduit in old buildings is difficult and expensive. Conduit is made of high grade steel and is heavily coated with a black enamel or a galvanized finish. Current is carried through two or more insulated indoor wires drawn through conduit. Thin-wall conduit, considerably lighter, is easily cut or bent, and no threading is necessary. See page 27 for method of installation.

4 ***"Knob and tube" wiring*** consists simply of ordinary insulated indoor wire, supported by porcelain knobs and tubes. Its chief advantages are low material cost and easy installation. Very often it is selected for buildings where moisture or acid is present so that frequent inspections can be made. Concealed "Knob and Tube" wiring is sometimes used in farm houses, although it is losing favor for this purpose. It is also commonly used in buildings near rivers within reach of flood waters.

If wires are exposed, system is known as "Exposed Knob and Tube;" if concealed in walls, it is known as "Concealed Knob and Tube" work. While the National Electric Code accepts "Knob and Tube" wiring, it is not permitted in some localities. Consult your REA Cooperative or Local Power Company before installing. See page 26 for methods of installation.

Installation of armored cable



Armored Cable Wiring is subject to the same general restrictions as non-metallic sheathed cable. Read carefully the rules for both "exposed" and "concealed" work as outlined on the opposite page.

Use steel fittings only. Armored cable may be used only with steel outlet boxes or switch boxes, never with bakelite or porcelain boxes.

Anchoring cable. Cable must be supported by a strap or staple every 4½ feet and within 12 inches of every outlet or switch box, except for concealed runs in old work where it is impossible to mount straps.

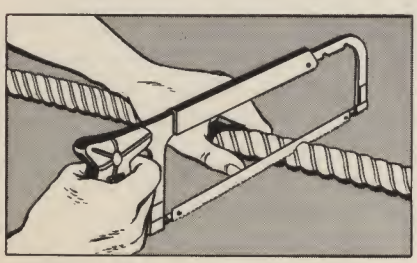
Cutting the cable. The steel strip wound around the insulated wires is easily cut and removed. Take an ordinary hacksaw and cut partially through one section of the armor as shown below. Be sure not to damage insulation of the wires. Grasp cable with one hand on each side of the cut portion and twist sharply. This will break uncut part which can then be slipped off.

Inserting the bushing. After the armor has been cut away, a rough jagged edge will remain. To avoid injury to the insulated wires, the Code demands that a bushing be inserted at the cut end of cable. This is a safety precaution and must not be overlooked.

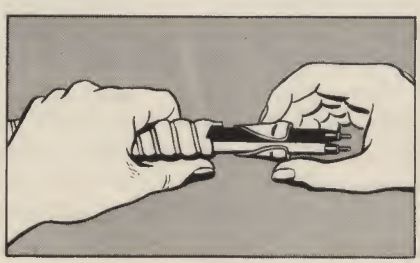
Connecting to boxes. Illustration below shows how connector is slipped over end of cable and over fiber bushing and secured by tightening connector screw. The threaded end of connector is inserted into the box knockout and secured by locknut as shown above. Boxes are also available with special clamps for armored cable, in which case no connectors are needed.

Ampere Capacities for Armored or Sheathed Cable

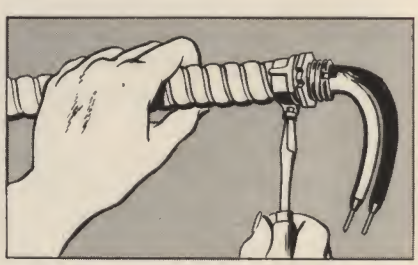
Size Wire	No. 14	No. 12	No. 10	No. 8	No. 6
Maximum Cap	15 Amps	20 Amps	25 Amps	35 Amps	45 Amps



1. Holding saw blade at an angle, cut through one section of armor only, then twist sharply to break uncut portion.

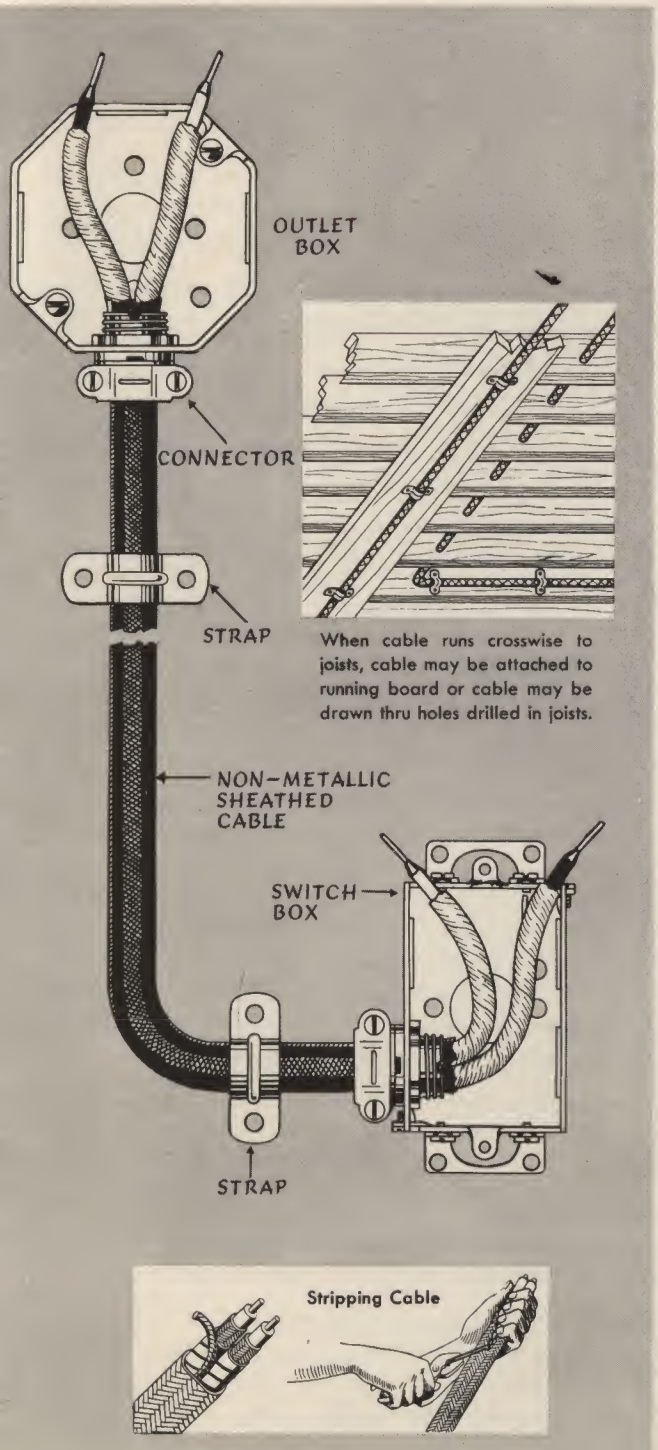


2. Insert protective fiber bushing between the armor and the wires so that wires and cut edge of armor will not be in contact.



3. Always allow 6 to 8 inches of insulated wire for making connections within boxes before fastening the connector to cable.

Installation of sheathed cable



Non-metallic sheathed cable may be used with either steel or Bakelite boxes. Splices may be made only within the boxes.

Stripping cable. The protective sheathing is easily removed by a built-in ripcord, which, when gripped and pulled, splits the outer insulation of cable (see lower left). When stripping cable allow 6 to 8 inches of insulated wire for making connections. A connector is then fastened to outside covering of cable, inserted in knockout hole of box and locknut screwed up tight from inside. Boxes with built-in clamps are also available for use with sheathed cable, in which case no connectors are necessary.

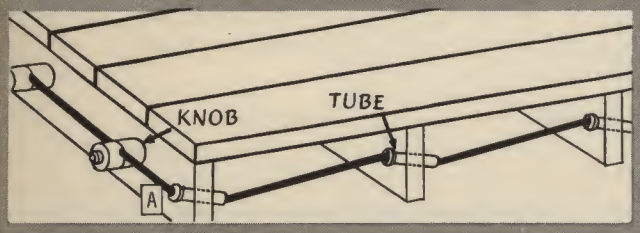
Rules for exposed work. Cable must be strapped every 3 feet and must be run on some supporting surface such as stud, joist, wall or ceiling. When run across joists or through open spaces cable must be supported by a running board (usually 1x2-inch) or drawn through supporting holes drilled in joists. (See illustration at left.) Bends in cable shall be made so that the protective covering of cable will not be damaged. Cable must be specially protected from mechanical injury where necessary by conduit, pipe, guard strips, or other means. When passing through a floor, cable should be protected by encasing it in conduit or pipe extending at least 6 inches above the floor.

In attics or roof spaces cable can be run across the top of floor beams, or across the face of attic rafters at a height at least 7 feet from the floor, provided the cable is protected by guard strips. If attic is not accessible by permanent stairs, guard strips will be required only within 6 feet of nearest edge of scuttle-hole or ladder entrance.

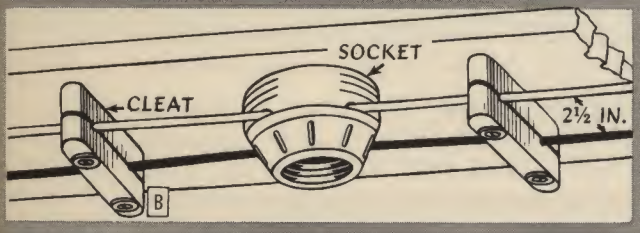
Rules for concealed work. Fasten cable with steel straps (never with staples) at least every 4½ feet, also within 12 inches of every outlet box or switch box. In wiring a new building, straps must be used regardless of whether cable will be concealed or left exposed. In wiring old buildings, straps must be used for all exposed runs, but for concealed runs where wires must be fished through floor or wall, straps need not be used.

See table on opposite page for allowable amperage capacity for each size of wire.

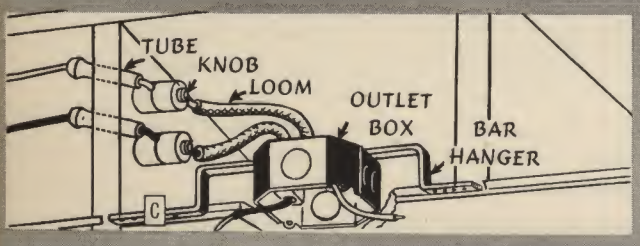
Installation of knob and tube wiring



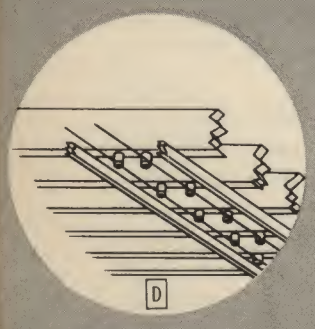
Use tubes for protection in passing wire through timber



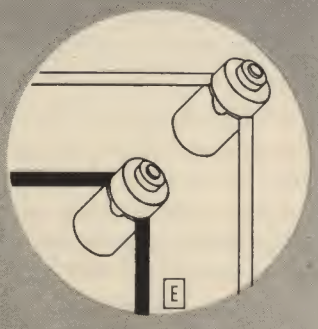
Correct method of installing closed terminal socket



Bar hanger support used for ceiling box installation



Guard strips protect wires



Use knobs to turn corners

The use of No. 10, No. 12, No. 14 insulated indoor wire with porcelain fittings in "knob and tube" wiring may be subject to definite restrictions. Be sure your local code permits this method of wiring. Not recommended for installations requiring wire larger than No. 10.

Wire and clamps. Use white wire for the "neutral," use black or red for the "hot" wires. No connectors needed for switch or outlet boxes . . . just tighten clamps inside boxes.

Porcelain knobs are used to support wires along wall or ceiling surfaces. Use in either exposed or concealed work.

Porcelain cleats—may be used for supporting wires on exposed work but not in concealed work or in attics.

Loom—flexible non-metallic covering for protecting wires where they enter boxes, or run close together.

Rules for concealed work. Wires must be supported every 4½ feet, must be at least 3 inches apart and 1 inch from their supporting surface. Therefore, use knobs. For best separation run each wire along a separate stud.

Rules for exposed work. Wires must be supported on knobs or cleats every 4½ feet or less, must be separated from each other by at least 2½ inches, and must be at least ½ inch from supporting surface.

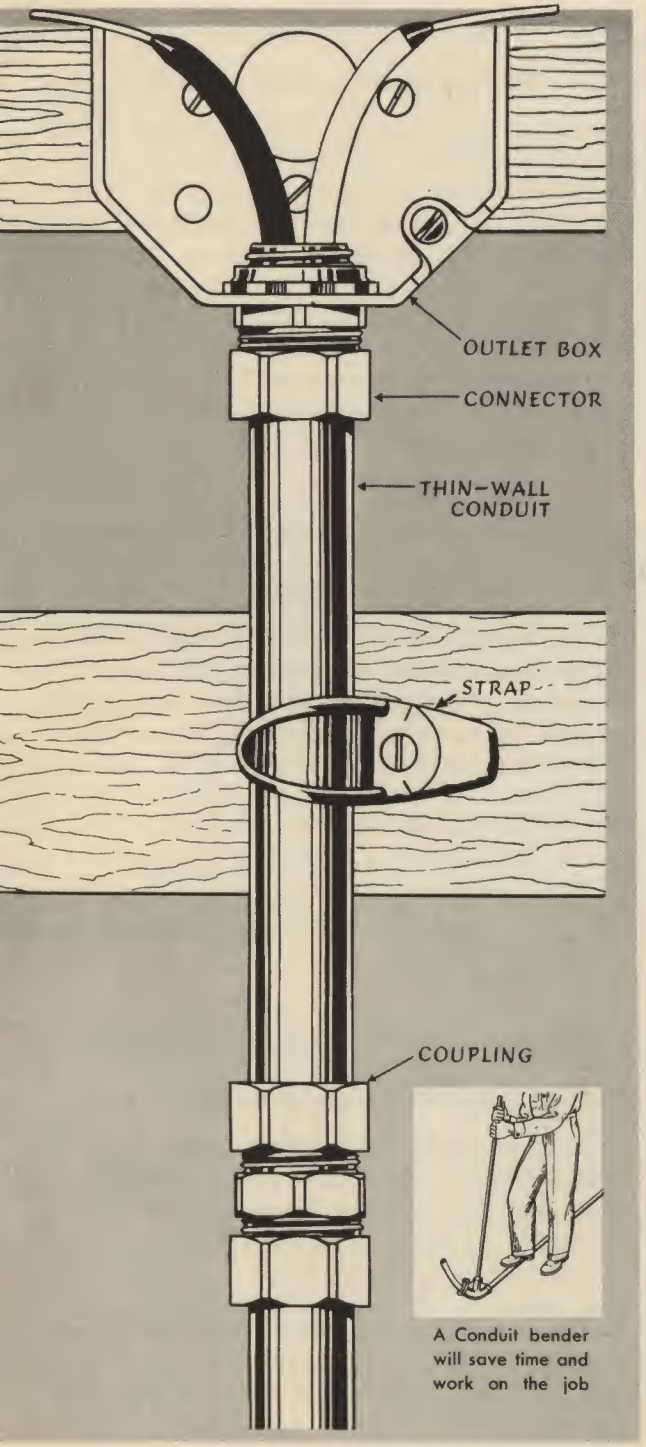
Where space is limited and 2½-inch separation cannot be maintained, encase each wire in loom. Where wires run crosswise of joists they must be protected with guard strips as shown in illustration D. Exposed work in attics must be run on knobs (not cleats). It is better to bore holes through joists or rafters and then run wires through porcelain tubes in these holes, see illustration A. Where exposed wires cross put porcelain tubes or pieces of loom over each wire and secure them with tape.

Illustration A shows tubes through joists at a downward angle. Tubes inserted so that the large ends are at the higher level, preventing tube from slipping out of hole.

Illustration B shows closed terminal socket. Place socket between the wires, then strip a small part of the insulation from each wire and slip under socket contact screws.

Illustration C shows ceiling outlet box installation. A ⅝-inch hole is drilled through joists for tubes, through which wires are run to the box. Loom is used where wires come close to each other before entering box.

Installation of thin wall conduit



A Conduit bender will save time and work on the job

Conduit may be used only with steel outlet or switch boxes, never with bakelite or porcelain boxes. Splices and connections may be made only within boxes.

The first step. Empty conduit should be mounted in place and connected to boxes ***before the insulated indoor wires are inserted.*** Conduit is furnished in 10-foot lengths which are joined by couplings. Smaller lengths can be cut with a hack-saw. Cut ends should then be reamed inside and tapered with a file to remove rough edges. Conduit can be easily bent, preferably with a Conduit Bender which can be purchased at little cost or you may use a pipe "T," connected to a length of pipe for a handle. Bends should be made so that conduit is not injured.

Supporting conduit. Use a pipe strap every 6 feet on exposed runs, every 10 feet on concealed runs.

Connecting to boxes. Illustration shows a conduit connection to an outlet box. Note that the threadless end of connector has been fitted over the conduit and the threaded end then inserted through box knock-out where it is secured inside box by a locknut.

Inserting insulated indoor wires. After conduit and boxes are installed the wires may be pulled through conduit and into boxes. To pull wires through conduit use a fish tape or a length of spring steel. Leave 6 to 8 inches at each box for connecting wires to switches and receptacles. Methods of connecting wires are the same as for armored or non-metallic sheathed cable. Use white wire for the "neutral," use black or red for "hot" wires.

What size conduit to use. Following shows size to select, depending on size and number of wires used:

½-inch conduit carries four No. 14 wires, three No. 12.
¾-inch conduit carries four No. 10 or 12 wires, three No. 8.
1¼-inch conduit carries four No. 6 wires, three No. 4.

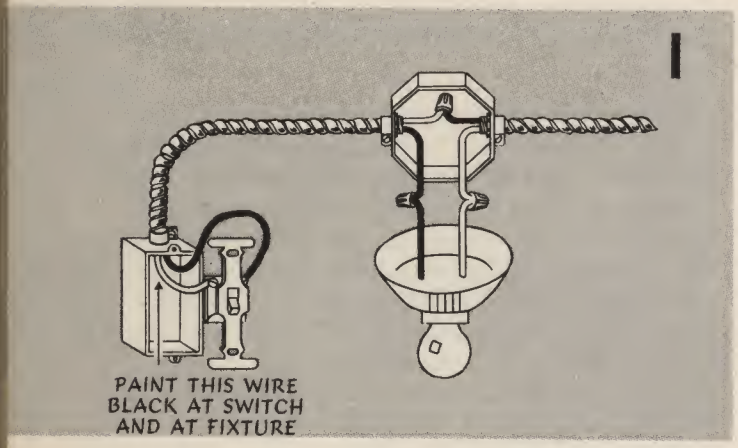
In exposed work conduit may be mounted on studs, walls, or rafters, without additional protection. ***In concealed work*** between walls or in ceilings conduit must be supported by notches in studs or rafters. See page 35 for further details.

Ampere capacities of insulated wire in conduit

Size wire.....	No. 14	No. 12	No. 10	No. 8	No. 6	No. 4
Maximum Cap.	15 amp.	20 amp.	25 amp.	35 amp.	45 amp.	60 amp.

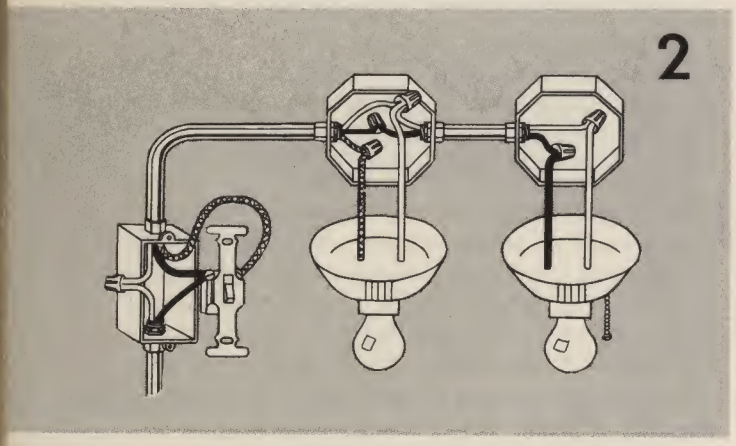
Rules above also apply for rigid conduit, but this method is rarely used in farm and home wiring.

Wiring diagrams for most common



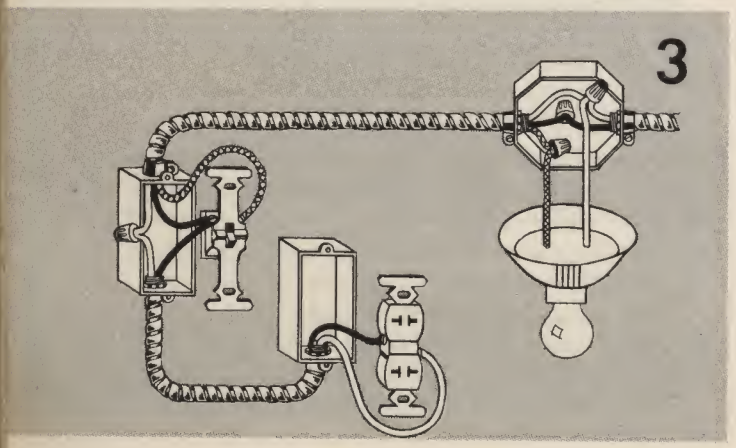
Adding a wall switch to control ceiling light at end of run

Wiring is simple. Run 2-wire cable, (Armored, Non-Metallic Sheathed or Conduit) from the ceiling outlet to point where the switch is to be located. Inside the ceiling outlet box disconnect the black wire from the fixture wire and connect it to the white wire which runs to the wall switch. Black wire from wall switch is then connected in ceiling box to the black fixture wire. Note that both ends of white wire from switch must be painted black to indicate that it is a "hot" wire. See illustration.



Installing two ceiling lights on same line; one controlled by switch

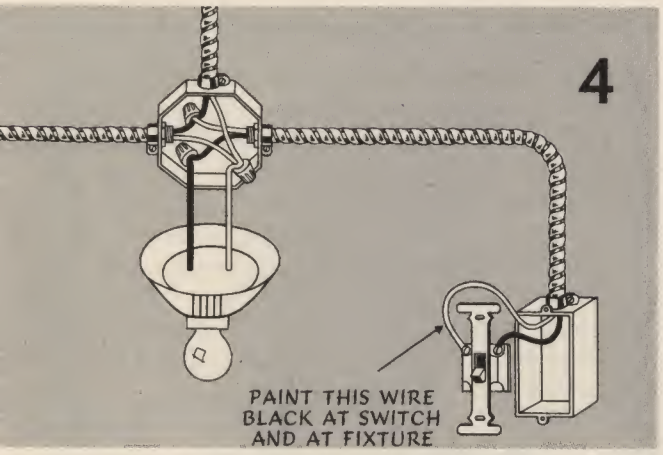
Conduit would generally be used on "new" work. This wiring scheme can also apply to "old" work . . . for example, adding a closet light from an existing bedroom light, using Non-metallic or Armored Cable. 3 wires are necessary between switch box and first outlet, two wires between the first and second outlet. White wire is run from switch box to both outlets. Red wire is run from one switch terminal to first outlet. Black wire is connected to the other switch terminal and is run to the second outlet.



Adding a switch and convenience outlet beyond existing ceiling light

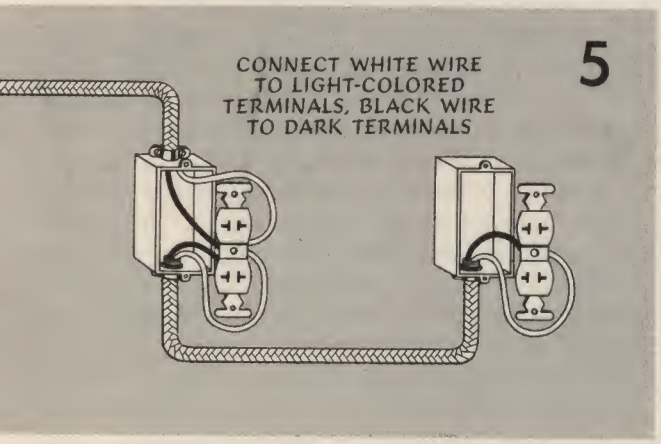
So that convenience outlet will be independent of switch and always "on", 3-wire cable from the ceiling outlet to the switch box is necessary. However, 2-wire cable is used from switch box to convenience outlet. The black wire is connected to one terminal of the switch . . . it also runs to the dark colored terminal of the convenience outlet. The red wire is connected to the other switch terminal, and the white wire is run from ceiling outlet, past switch to light-colored terminal of the convenience outlet.

Switch and outlet combinations



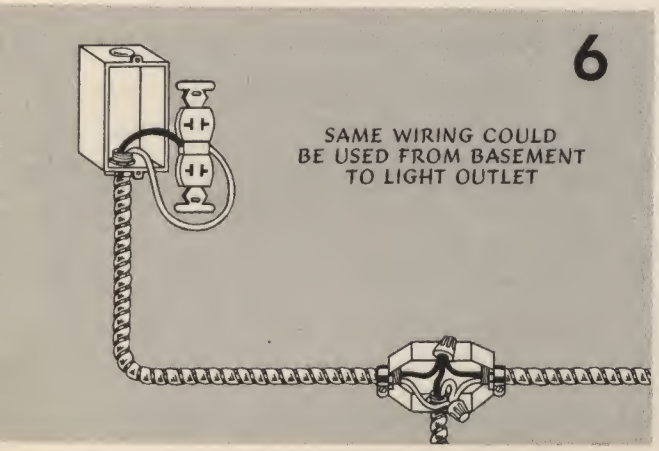
Adding wall switch to control ceiling light in middle of run

In this case the circuit is continuous through the ceiling outlet to other outlets on the same line. The same wiring is used as in No. 1 (opposite page). The only difference is that the wires leading to switch are tapped off in the ceiling box as shown. Black wire from the switch must be connected to the black wire of the fixture. Connect white wire from switch to black wire in ceiling box. Note that both ends of the white wire from the switch must be painted black to indicate that it is a "hot" wire.



Adding new convenience outlets beyond old convenience outlets

Providing plenty of outlets in each room for lamps and appliances keeps rooms free from tangled cords. Wiring from one outlet to another is simple as illustration shows. Select the spot where new outlet will be located and prepare opening for outlet box. Use 2-wire cable (Non-Metallic Sheathed, Armored or Conduit). Connect the black wire of cable to the dark (brass-colored) terminals of both the old and new outlets. Connect the white wire of cable to the light-colored terminals of both outlets.



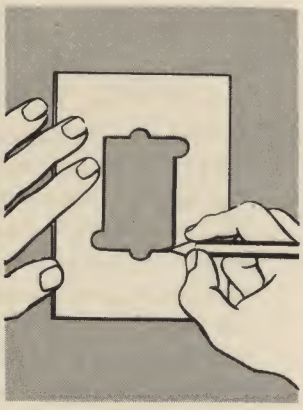
Adding a new convenience outlet from an existing junction box

This method is usually used where junction box is in basement and outlet is to be on floor above. Use 2-wire Armored Cable, Non-Metallic Sheathed Cable or Conduit. Within the junction box tap the black wire and connect it to the black wire leading to the convenience outlet, then do the same with the white wires. In connecting outlet, hook black wire to the dark brass-colored terminal and white wire to light-colored terminal. For other details on how to bring wires up through floor, see page 33.

PART 3

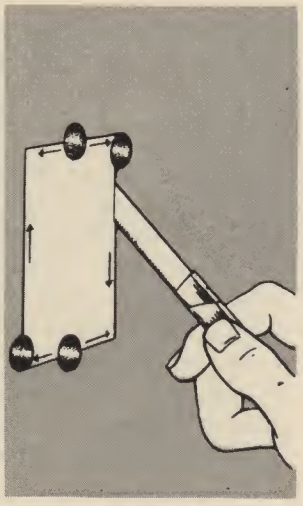
Installation methods

1. Sound for studs

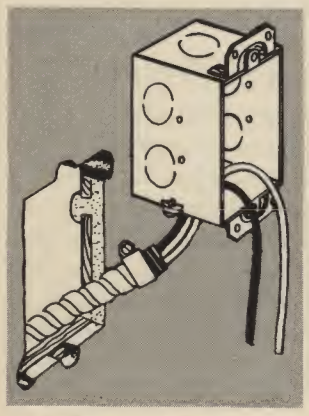


2. Outline Template

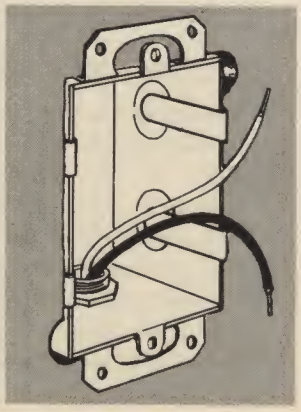
3. Drill ½ inch Holes



4. Cut with Blade



5. Draw wires into box



6. Anchor box to wall

How to select location for boxes

Boxes must be located between the studs. You may be able to locate position of studs simply by sounding the walls by rapping with hands as shown. If not, drill to find studs, using a 1/16-inch drill. Drill holes every two inches until drill strikes stud. Drill just above baseboard so holes will not be noticed.

Use of Template: Once studs are located, chip away plaster to locate laths. (See warning for lath and plaster work on opposite page.) Next, using a soft pencil and a Template (see page 16), outline position for box as in figure 2.

How to cut opening in wall

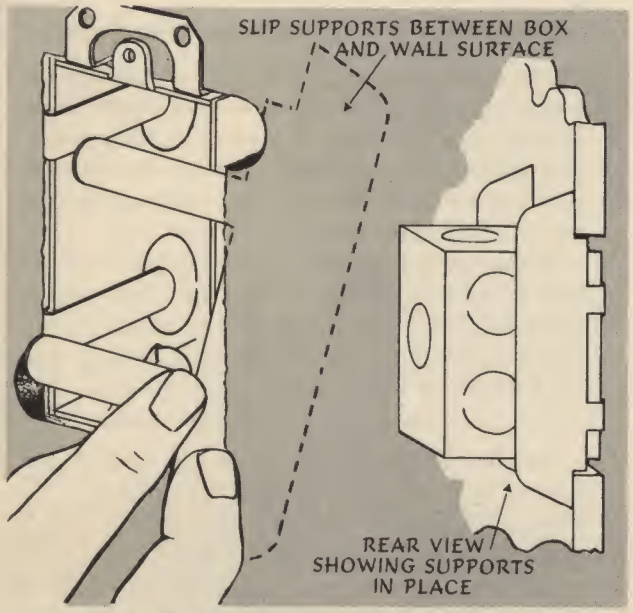
Be sure to place switches and outlets at correct height for convenience. Switches should be located about 48 to 54 inches above floor, convenience outlets about 12 to 18 inches above floor, or at table height in kitchen and dining room. Locate switch boxes as near to a stud as possible. As soon as Template is outlined, bore four holes in wall by using a ½-inch bit as shown in figure 3. These holes provide space for hacksaw blade. When holes are drilled, cut lath and plaster in direction of arrows as in figure 4. When using hacksaw blade the cutting pressure should take place as you draw the blade toward you to avoid the possibility of loosening plaster from the lath. Always hold your hand or a small board against plaster as you saw, to prevent the plaster from cracking or chipping.

How to connect box to cable

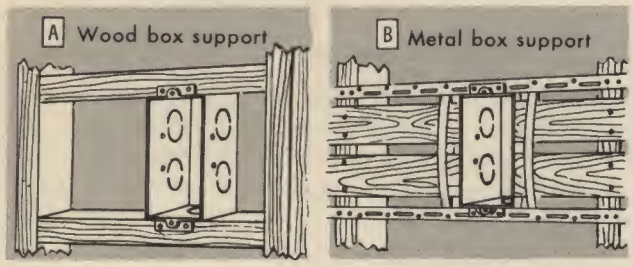
After opening is cut the next step is to draw the cable out of the hole in wall and insert the wires through knockout holes in box as in figure 5. Then place cable and box into hole in wall and with a locknut fasten connector within box.

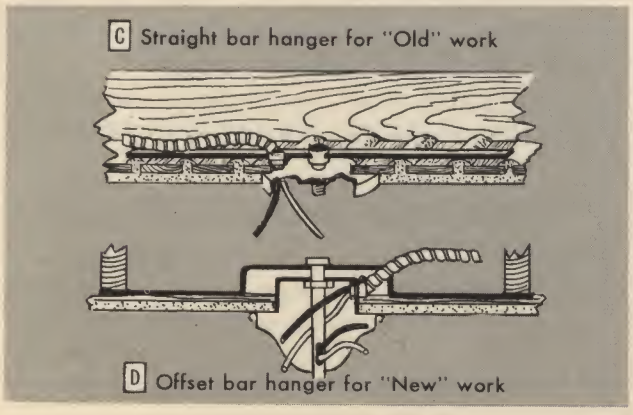
Boxes range in depth from 1½ to 2½ inches. Use the large size when possible to allow plenty of room for wires. 1½-inch boxes are used only where space is limited. When anchoring box to wall we suggest the use of metal box supports shown in figure 6. (See opposite page for full instructions.) Boxes range in depth from 1½ to 2½ inches.

for "Old" and "New" buildings



Method of inserting metal box supports in "Old" work installations

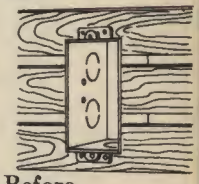




Mounting Boxes in "Old" Work

To save time and labor, we recommend the use of metal box supports, as illustrated. They are made of light sheet steel or tin, are inexpensive and can be used with any materials . . . plaster and lath, wallboard, plaster-board, or steel lath. They can be mounted in a minute or less and assure a better, stronger installation.

How to use Metal Supports. Place box with connected cable in wall opening, then insert box supports to each side of box next to plaster. Next, work the supports up and down until they fit firmly against inside surface of wall . . . then bend projecting ears so they fit around the walls of box.



Warning, for lath and plaster. When cutting openings in lath for boxes ***do not cut away two full laths.*** You will have a stronger mounting by cutting out one center lath completely and half sections from each lath above and below. (See sketch at right.) Before outlining position of box with Template you must chip away a small section of plaster to find laths.

Mounting Boxes in "New" Work

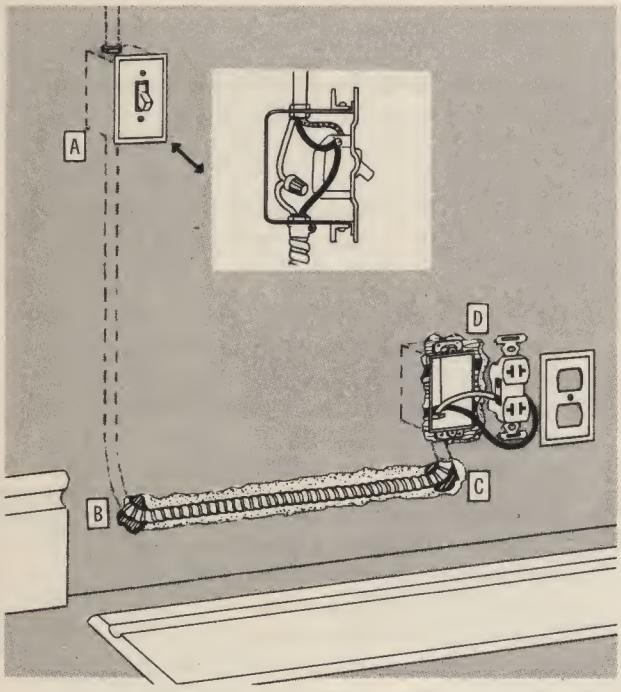
Method [A] shows how strips of not less than ⅞-inch board may be used. Strips should be set flush with front of studs. Method [B] shows "Kruse Strip" which supports several switch or outlet boxes at any point between studs.

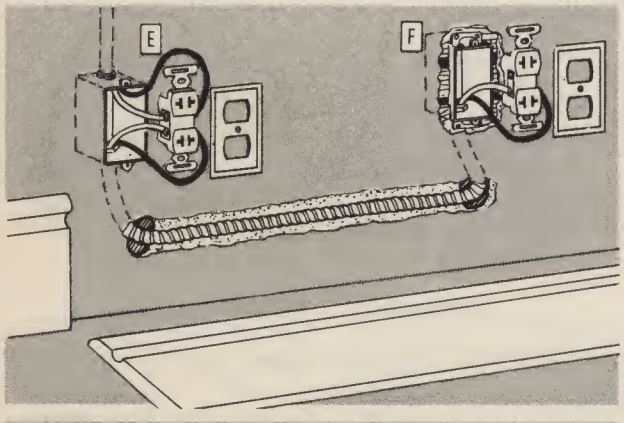
Mounting Ceiling Boxes

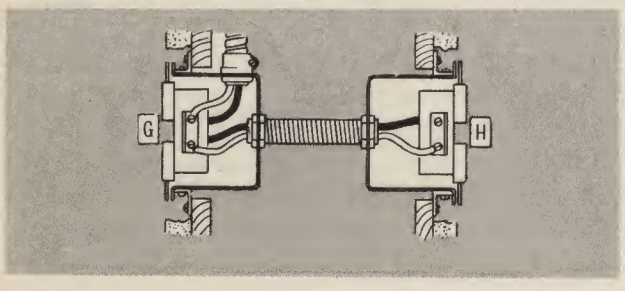
In "old" work the ceiling outlet may be installed if necessary with a shallow box and straight-type bar hanger as shown in method C. It is the method usually used where box is not accessible from above and work must be done from below. Notch away plaster to the size of the outlet box, then cut the lath that is closest to the center. Insert hanger through the opening. Adjust bar hanger in place and center the sliding stud. Fasten box to hanger.

In "new" work use boxes at least 1½-inch deep, anchored with off-set bar hanger as in method D.

Commonly used methods of installing







1 From wall switch to baseboard outlet

The method illustrated at left generally affords the easiest way of installing a convenience outlet. It can be used, however, only if there is a neutral wire available in switch box A or, if there is conduit from A to the ceiling outlet, in which case the neutral wire can be fished through.

1st Step. Select location for receptacle and cut hole in wall as shown on page 30, then remove baseboard and cut holes B and C directly below switch A and receptacle D. Notch channel in plaster, between two laths, deep enough for cable. This makes it unnecessary to cut through studs.

2nd Step. Remove knockout in box A. Fish wire from A to B. Attach a connector to cable. Attach cable to fish tape and pull cable into knockout in A. Then run cable thru hole C to box D.

3rd Step. Connect cable wires at A and D as illustrated (black wire to dark-colored terminal o receptacle and white wire to light-colored terminal)

4th Step. Fasten cable securely to boxes with connectors, and then mount boxes in wall.

2 Wiring from one outlet to another

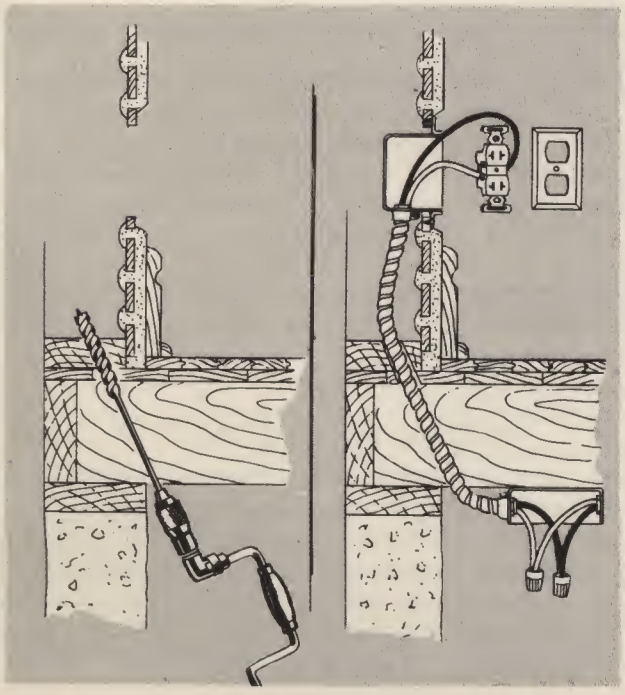
Preliminary steps for this installation are the same as above . . . remove baseboard and cut holes in wall where new or additional outlets are to be located. Then notch a channel in plaster for running cable along outside of wall, behind baseboard.

Next, cut a length of 2-wire cable long enough to extend from outlet box E to where new outlet box F is to be added. Place the cable in groove, and clamp securely to each outlet box. Connect wires within each outlet box as shown . . . the black wires to the dark-colored terminals, and the white wires to the light-colored terminals. When replacing baseboard be sure no nails are driven into cable.

Wiring outlets in adjoining rooms

If outlets are to be back-to-back in adjoining rooms, (see G to H at left) cut holes in walls of both rooms, opposite each other, and connect wiring from one receptacle to another using either conduit or threaded nipple with locknuts.

extra convenience outlets in "old" work



3 Wiring through floor from basement junction box to a first-floor outlet

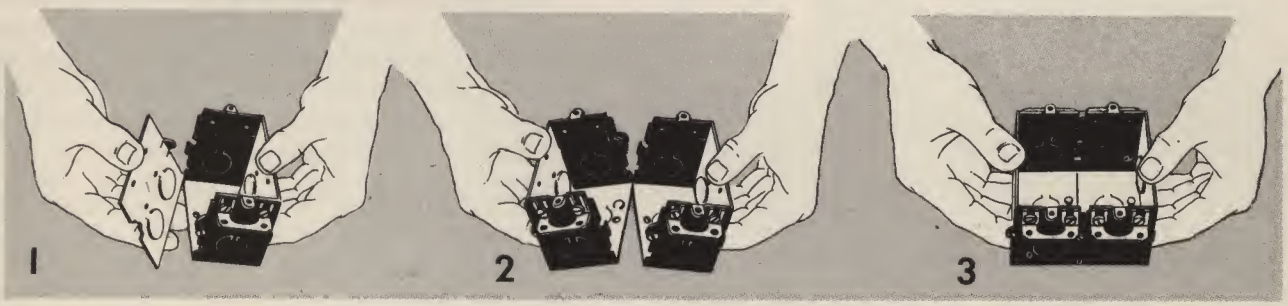
Use either armored or sheathed cable in a continuous length from junction box to baseboard outlet.

Step 1. Select location for outlet and prepare the opening . . . cutting through plaster and laths.

Step 2. If outlet is to be on an outer wall, bore a hole diagonally (as shown) through floor from basement side upward, using a long-shank bit. If outlet is to be on an interior wall you can usually bore the hole through floor directly upward to partition between walls.

Step 3. By pushing a length of fish wire up hole from basement and attaching cable to it you can easily pull wires through to the outlet opening.

Step 4. Attach cable to boxes. Make connections inside boxes as shown. Connect black wire to dark terminal, white wire to light-color terminal.



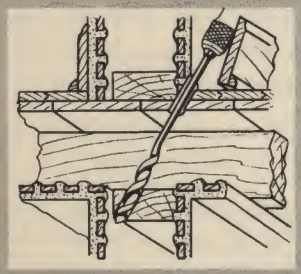
How to gang metal boxes for switches and convenience receptacles

When more than one outlet is controlled from a given point (for instance, two or more switches at one location to operate lights in different rooms), they can be grouped under one switch plate. This is called ganging. Switches and receptacle outlets are mounted in the same kind of box . . . a sectional switch box. Metal switch boxes are constructed so that any number of them can be ganged together. The sides of each box are removable so that boxes can be fastened to each other by simply removing one side of each box, placing them together and tightening into place. The steps in joining boxes are illustrated above: ***1.*** Remove wall end of each box. ***2.*** Fit boxes together. ***3.*** Tighten up the screws. This applies only to metal boxes, not to bakelite boxes.

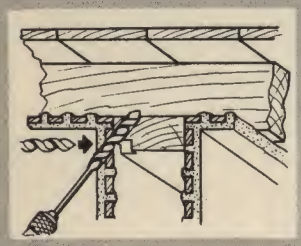
Important note: Care should always be taken when punching knockouts. Punch only the knockouts you intend to run wires through, so that box will not have any hole unused. Open holes in boxes represent a fire hazard and must be plugged with knockout filler.

Commonly used methods of installing

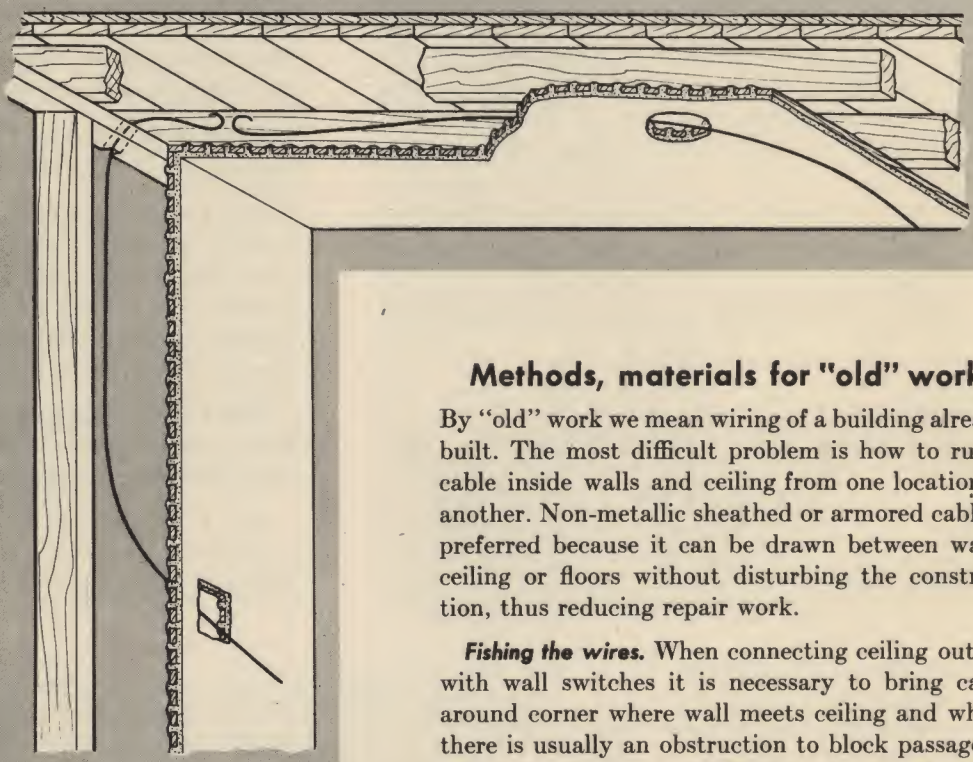
2 ways to drill

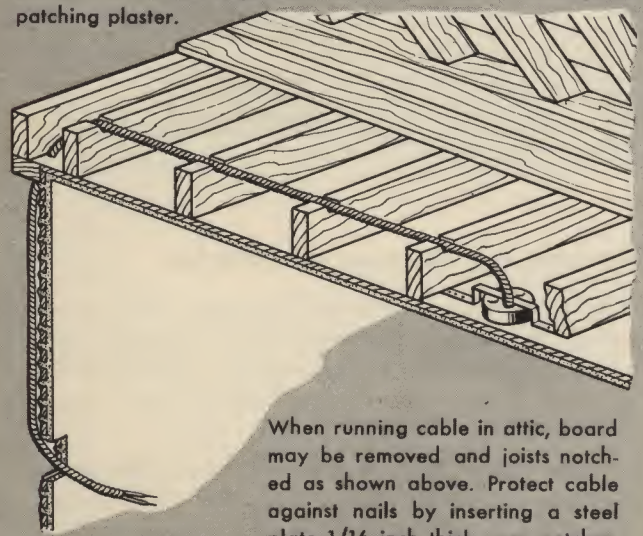


1. Remove baseboard on second floor, then drill diagonal hole downward



2. Drill diagonal hole upward from opposite room. Then drill horizontally until holes meet to provide opening for cable. This method requires patching plaster.





When running cable in attic, board may be removed and joists notched as shown above. Protect cable against nails by inserting a steel plate 1/16 inch thick over notches.

Methods, materials for "old" work

By "old" work we mean wiring of a building already built. The most difficult problem is how to run a cable inside walls and ceiling from one location to another. Non-metallic sheathed or armored cable is preferred because it can be drawn between walls, ceiling or floors without disturbing the construction, thus reducing repair work.

Fishing the wires. When connecting ceiling outlets with wall switches it is necessary to bring cable around corner where wall meets ceiling and where there is usually an obstruction to block passage of cable. Small views at left show two methods of drilling a channel in such cases.

After drilling the necessary opening by either of the methods shown, the next step is to draw cable through this opening by using fish wire. Bend a hook on one length of fish wire and push it through the opening you have drilled. Next, run another piece of hooked fish wire over from the ceiling opening and hook it to the first piece of wire as shown above. Once the two hooked ends are joined you can pull the first wire over to the ceiling opening so that you have a continuous run of fish wire inside the walls and ceiling. To end of this wire you then attach a continuous length of cable and pull it into position.

Where attic is accessible, as in wiring one-story houses or second floors, attic floor boards can be lifted and a hole bored with an electrician's bit through any obstruction, as shown at left.

Wall Switches in old and new work

Methods and materials for use in "new" work

By "New" work we mean wiring for buildings in process of construction. "New" work is much simpler than "old" work—it is just a matter of running wires to the various outlets and boxes along the most direct route.

In some localities, particularly urban areas, local regulations specify that all "new" work be done with conduit. The reason for using conduit, instead of Armored or Non-metallic Sheathed Cable, is that conduit wiring is less liable to injury. Also, it is simpler later on, to do minor rewiring, because wires can be pulled out of the conduit and larger ones installed.

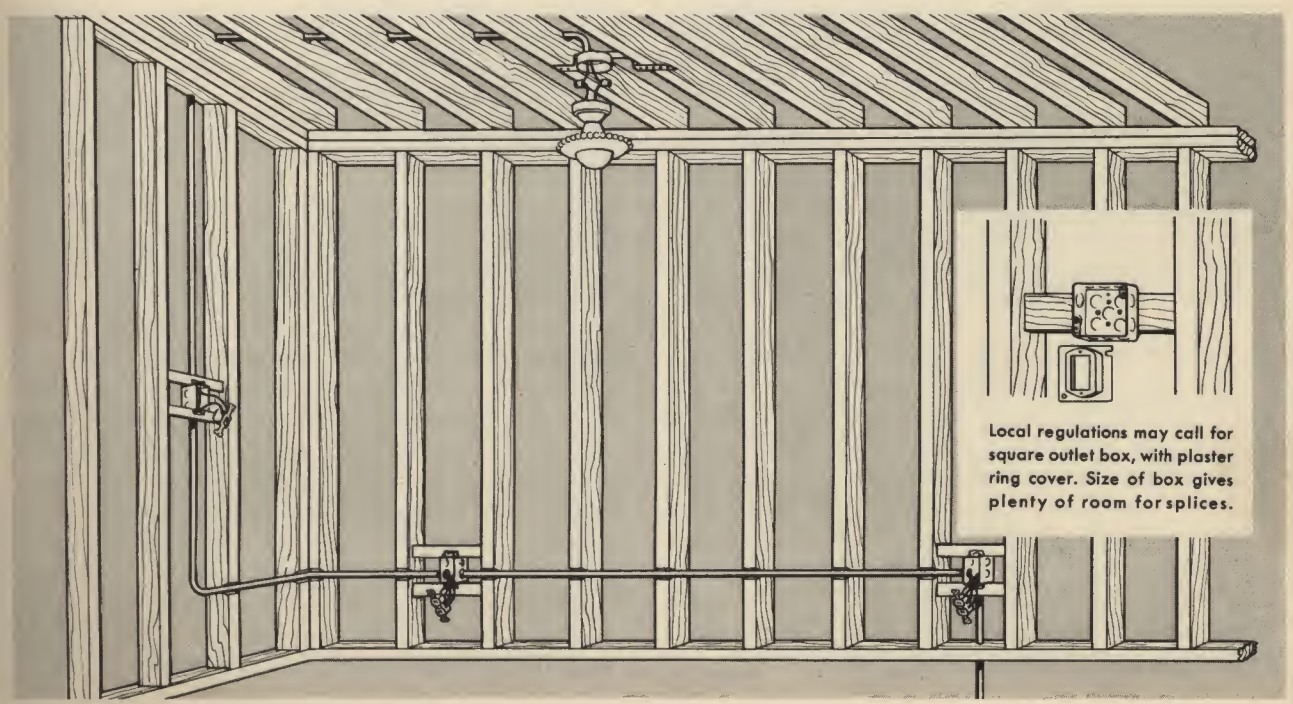
Installing conduit run. In "new" work the conduit run is put into place before house is completely built. Then, after house is finished and walls plastered, wires are run through conduit and connected to switches and outlets. See page 27 for information about handling conduit and connecting to boxes. When bending conduit make gradual bends. Abrupt bends might cause damage to the insulation. Do not have more than four quarter bends in a run of conduit from one outlet to another. Otherwise, it will be difficult to insert wires.

Anchoring conduit. Where conduit runs along the side of a stud or joist it should be supported every 6 to 8 feet with a pipe strap or clamp. Where conduit runs horizontally across wall studs or joists as shown below, cut notches to provide a channel for conduit.

The final step. Wires should not be drawn through conduit until conduit is installed and plaster finished. Be sure that wires used in the system conform to color code . . . in a 2-wire circuit, one black, one white . . . in a 3-wire circuit, one black, one white, one red.

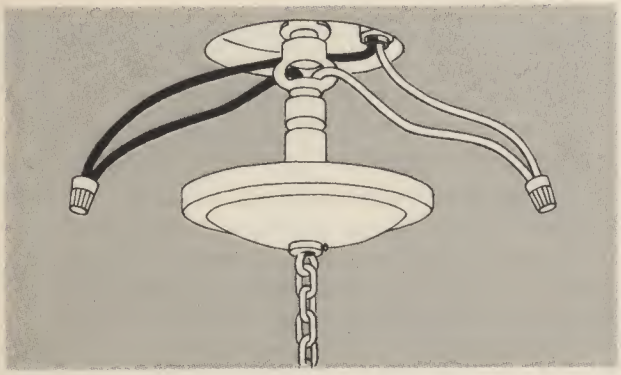
Wires must be continuous from outlet to outlet. Pull boxes or junction boxes shall be so placed that they are easily accessible at all times.

Use of fish tape. Where the run is short and has only one or two bends it is possible to push wires through conduit. Where the run is long and several wires are to be inserted; fish tape will be needed. Fish tape comes in 50 and 100 foot lengths. In straight runs tape moves smoothly, but where bends occur, drive fish tape back and forth until bend is passed. Soapstone or talcum powder may be used as a lubricant.

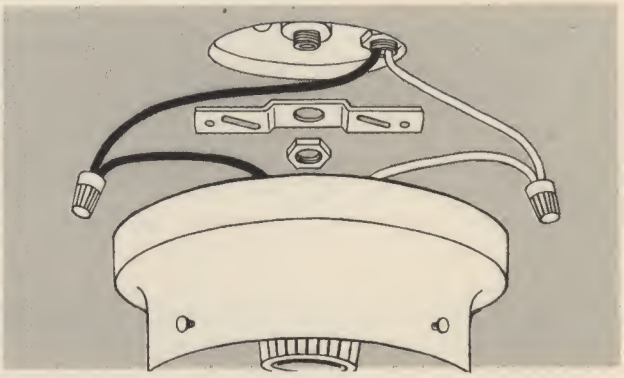


Local regulations may call for square outlet box, with plaster ring cover. Size of box gives plenty of room for splices.

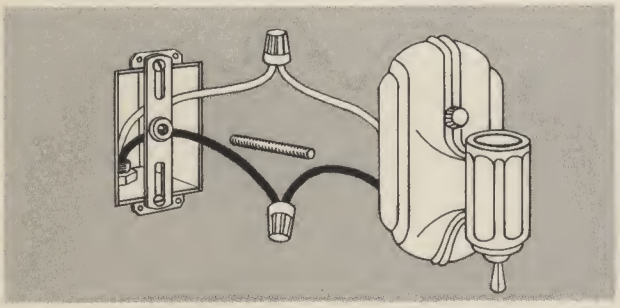
Wiring lighting fixtures



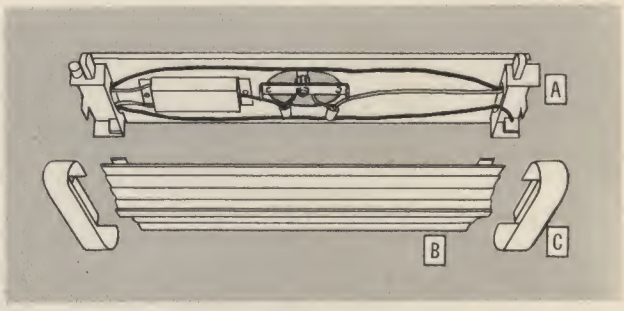
Ceiling drop fixtures are held by means of a stud in ceiling outlet box. Usually there is a hickey used between the stud and the stem of the drop fixture. However, some manufacturers thread the stem of the drop fixture so that it can be screwed on the stud, eliminating the use of a hickey. Wires are brought through a slot in the stem or through the hickey. Connect wires with solderless connectors as shown. Push the canopy to fit flush with ceiling and secure with locknut.



Kitchen ceiling fixtures. Furnished with this type fixture is one strap, one ⅜-inch locknut, two screws and two solderless connectors. Install as follows: Place strap over fixture stud in outlet box and fasten with locknut. Bring fixture holder up close to ceiling and connect wires from outlet box to fixture wires, using solderless connectors as shown. Place holder next to ceiling so that holes in holder are over holes in strap and fasten with screws. Then attach glass shade.



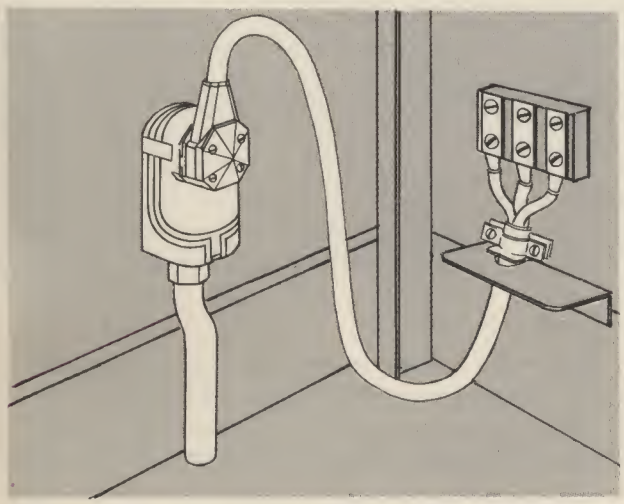
Wall bracket fixtures. A steel strap with locknut, a connecting screw and solderless connectors are usually furnished with this type of fixture. Install as follows: Anchor strap with screws to any standard size outlet box as shown. Insert connecting screw in locknut. Use solderless connectors to join fixture wires to wires in outlet box. Be sure to connect black wire to black wire and white to white wire as shown. Place the fixture over outlet box so that connecting screw extends through hole in fixture. Knurled cap on fixture is then easily tightened over connecting screw.



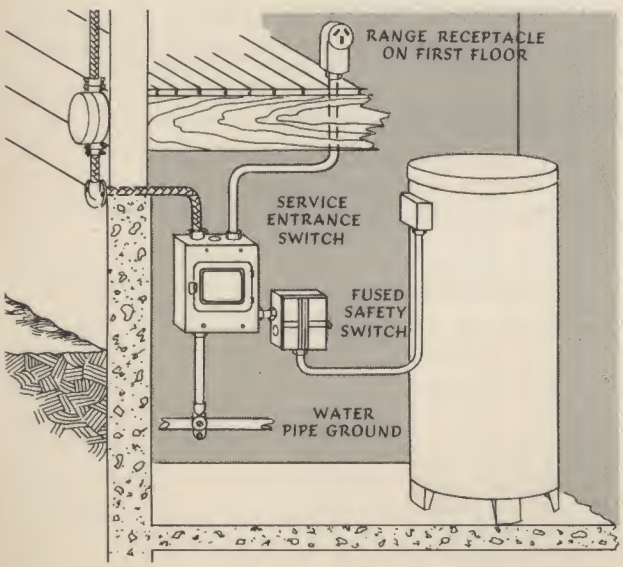
Fluorescent fixtures usually are made up of a chassis to which are mounted the sockets, ballast and wiring. Over the chassis is a metal cover, which is easily removed to mount fixture. To mount fixture insert stud in outlet box. If stud is not long enough then an extension nipple can be used. Place chassis over outlet box and bring stud of outlet box through the center hole of chassis (A) and fasten securely with a locknut. Connect wires . . . black to black, white to white. Replace cover (B) and insert starter bulbs and end caps (C).

Installing range and water heater

A separate 3-wire circuit must be installed for an electric range and also for most water heaters because both devices operate on 230 volts. An Entrance Switch rated to at least 60 amperes is necessary to permit the use of these two appliances. Heavy-gauge wire should be used in connecting them.



Typical Electric Range Installation



Typical Hot Water Heater Installation

Electric Range Installation: When an electric range operates at maximum heat it requires 230 volts, but at low heat it takes only 115 volts . . . therefore, a 3-wire cable must be used. A special heavy-duty 50-ampere 230-volt wall receptacle should be installed in the kitchen for the range. Mount this receptacle on the surface of wall or baseboard as shown. For wiring from receptacle back to the Service Entrance Switch you can use either No. 6 or No. 8 three-wire Cable depending upon wattage of range (the heavier No. 6 wire is preferred). Check this wire size with your REA or Power Company . . . also check whether Conduit, Armored Cable, Non-Metallic Cable or Entrance Cable should be used. (Where Entrance Cable is used the uninsulated wire is connected to neutral terminal on range receptacle.)

A flexible 3-wire cord or "pig-tail" is then connected to range terminals as shown. The other end of cord has a 3-prong plug to fit into range receptacle. Use of cord and receptacle permits range to be disconnected easily at any time.

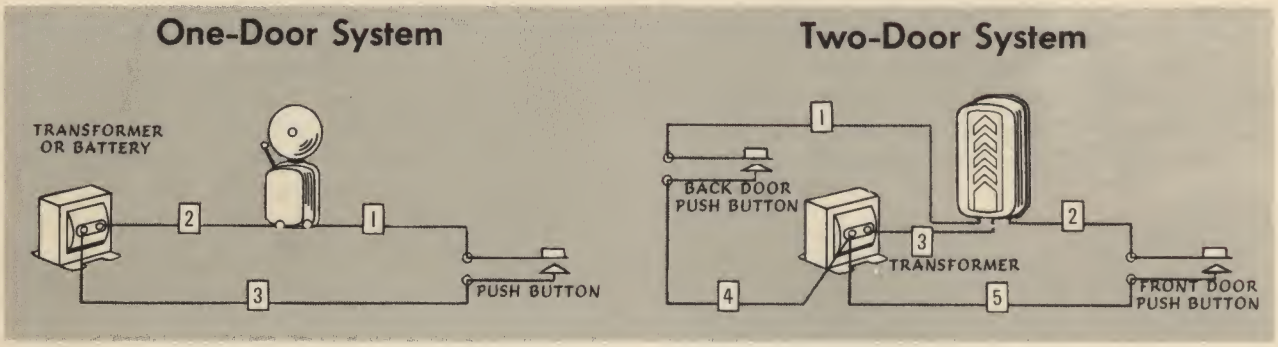
Note: Be sure that the metal frame of the range is grounded to the neutral terminal on the range.

Water Heater Installation: Power Companies usually offer an unusually low rate for current used to heat water. This is called "Off-peak-load rate," and is offered during the hours when the demand for current is not great. The Power Company will install a separate meter and time switch which turns on or shuts off at certain hours of the day.

Types of Heaters: A double-element heater differs from the single-element type in that it permits a more constant supply of hot water. Double-element heaters have two thermostats. Single-element type has one thermostat. The size of elements, type of thermostats and method of wiring are usually specified by your Power Company or REA Cooperative. Consult them before ordering a Water Heater.

Safety Switch. When Service Entrance Switch has an unfused tap for the Water Heater, use a Fused Indoor Safety Switch.

Installing door bells and chimes



Doorbells, buzzers, and chimes operate at low voltage. Voltage supply is obtained from a low voltage transformer; though dry cell batteries may be used.

Transformers reduce regular 115-volt alternating current to a much lower voltage, such as 6, 8, 10, 12, or 18 volts. Because of this low voltage, heavy insulation is not required. Bell wire is used from low voltage side of transformer and may be run behind baseboards, under molding, or under floor boards. Wires are secured with insulated staples.

Sometimes it is more convenient to wire the doorbells from batteries. 1½-volt batteries are used, usually connected in series to produce any voltage needed. For example, a 6-volt doorbell would require four 1½-volt batteries. (4 x 1.5=6 volts.)

Doorbell only, at upper left, shows the simplest type installation. Wires are run from terminals on the bell . . . (1) to push button and (2) to the transformer (or batteries). Another wire (3) is then run from push button to transformer.

Combination Bell and Buzzer. Signal bell for the front door and a buzzer for the back door. See illustration at upper right. Connect wire (1) and wire (2) from terminals on combination bell and buzzer to the push buttons; connect wire (3) to transformer. Next connect two wires (4) and (5) from terminal on transformer to each push button.

Chimes. Essentially same as above. Most chimes require 10-volts which may be obtained from some transformers. For best service use a chime transformer.

Important facts about Extension Cords

No. 16 extension cord or No. 18 extension cord are usually adequate for lamps or smaller household appliances. But when used to operate heavy electric motors or other high-wattage appliances, the extension cord must be heavy enough to carry a large electrical load. Overloaded cords overheat, waste current and often fail to deliver sufficient power to run motors at top efficiency.

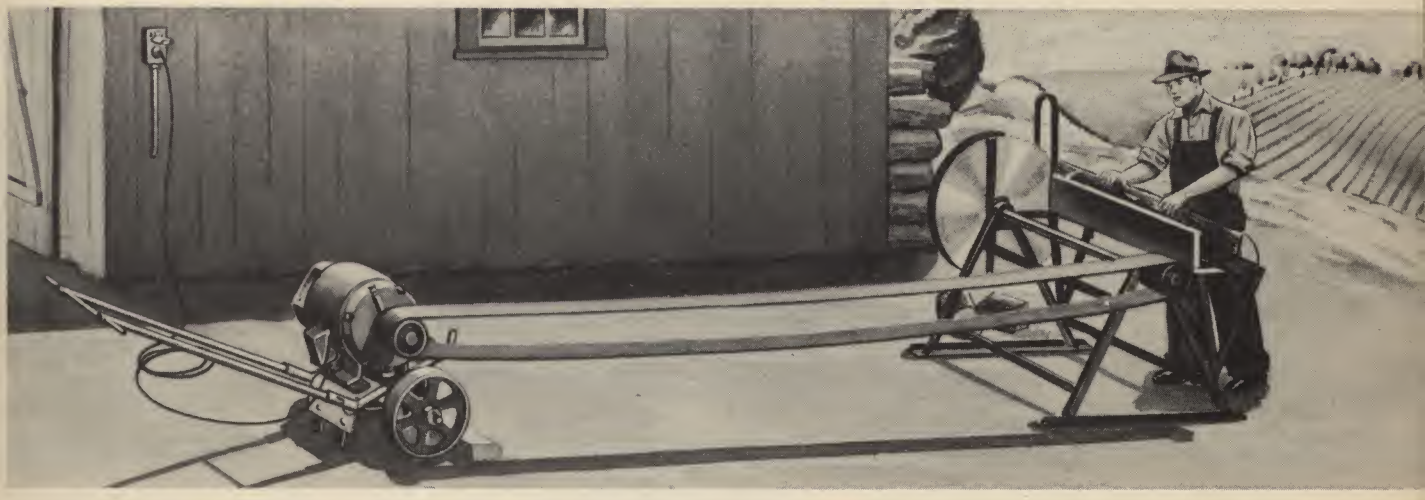
What size Extension Cords to use

Every size of wire has its maximum allowable current carrying capacity as shown in table at right. In addition the longer the cord the greater the current loss or voltage drop, so plan your wiring so that long runs of cord will not be necessary, either inside of buildings or for outside work.

Allowable current carrying capacity of flexible cord

Size of wire in cord	*Rubber type Cords PO, C, PD PWP, K, E and ED*	*Heavy Rubber or Thermoplastic type Cords S, SO, SJ, SJO, SV, POSJ ST, STT, STV, POT*	*Asbestos type Cords HC, HPD or HSJ*	*Asbestos type Cords AVPO AVPD*
No. 18	5 amps.	7 amps.	10 amps.	17 amps.
No. 16	7 amps.	10 amps.	15 amps.	22 amps.
No. 14	15 amps.	15 amps.	20 amps.	28 amps.
No. 12	20 amps.	20 amps.	....	36 amps.
No. 10	25 amps.	25 amps.	....	47 amps.
No. 8	35 amps.	....	....	....
No. 6	45 amps.	....	....	....
No. 4	60 amps.	....	....	....
No. 2	80 amps.	....	....	....

Providing for heavy electric motors



Provide enough outlets in Barn

The number of electric motors you intend to use and their sizes are factors that must be considered in your plans. In future years more and more of the work about the up-to-date farm will be done by electric motors. They possess more reserve power than gasoline motors, absorb temporary overloads better and need fewer repairs.

Be sure you provide a number of outlets for such motors to do heavy-duty jobs such as grinding feed, welding, drying hay or hoisting. Outlets for heavy-duty work should be on 230-volt circuit.

Heavy jobs demand larger motors

Most electric motors will stand overloads up to 200% for short periods or while starting, but continuous overloading can cause damage. Be sure the motor you use has sufficient horsepower for the job. Don't try to get a steady 2 H.P. load from a motor rated at only 1 H.P.

For safety, switches for starting and stopping motors should be installed in the most accessible locations. If extension cords are used for short runs be sure they are No. 14 wire or heavier. Never use ordinary lamp cords for a motor. See opposite page for other information about cords.

Large Motors require heavy wire

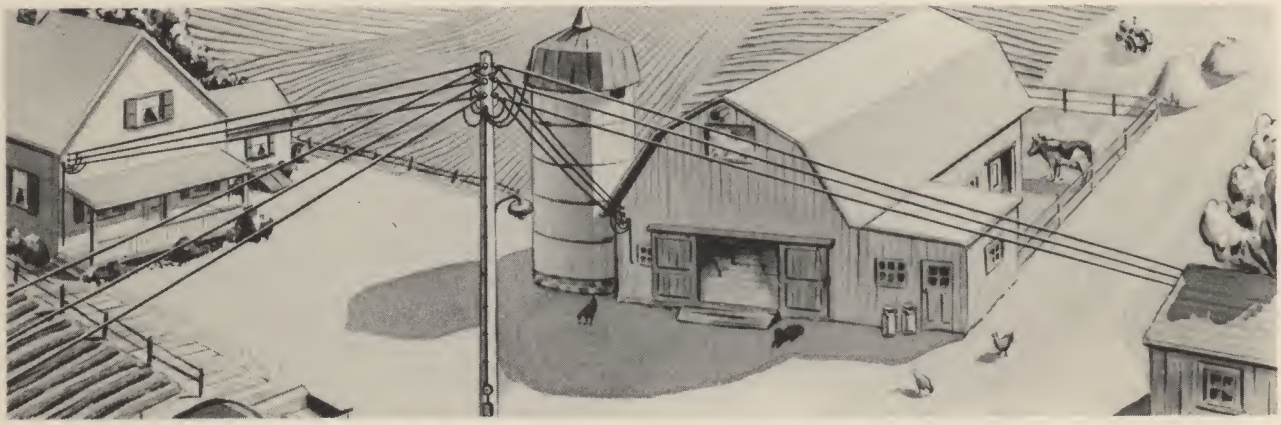
Generally any electric motor of ½ H.P. or less can be powered from a 115-volt outlet but 230-volt 3-wire service should be provided for any motor *rated above ½ H.P.* A ½ H.P. motor draws 600 watts, a 1 H.P. motor draws 1000 watts, a 2 H.P. motor draws 2000 watts and a 3 H.P. motor draws 3300 watts. Be sure your wiring is heavy enough to carry these loads when required. Distance of motor from the meter should be considered to avoid voltage drops which can cause motor to labor and overheat. See table below for wire sizes.

How to find size wire needed for a motor

In order to determine the correct size wire for permanent and portable motors, check the following:—
1—Check the distance from the meter to the motor.
2—Next check size of motor you intend to use.
3—Table below gives size wire you need.

Measure the distance of motor from meter	*Recommended Wire Sizes*					
	Using 115 volts		*Using 230 volts*			
	¼ H.P. motor	*½ H.P. motor*	*¾ H.P. motor*	*1 H.P. motor*	*3 H.P. motor*	*5 H.P. motor*
Up to 100 ft. . . .	No. 14	No. 14	No. 14	No. 14	No. 12	No. 10
100 to 200 ft. . . .	No. 12	No. 10	No. 14	No. 12	No. 10	No. 8
200 to 300 ft. . . .	No. 10	No. 8	No. 12	No. 12	No. 8	No. 6
300 to 400 ft. . . .	No. 8	No. 6	No. 10	No. 10	No. 6	No. 4
400 to 1000 ft. . .	. . . . .	. . . . .	. . . . .	. . . . .	No. 4	No. 2

PART 4 Wiring from yardpole



The first step in wiring the average farm is to bring electricity from the Hi-line to a yardpole on your property. This yardpole thus becomes the central distribution panel for feeder wires to all buildings. Your Power Company or local REA Cooperative will advise you as to the best location ***and will in most cases set up the pole and install all wiring leading into the meter which is usually installed on the pole.*** Wiring from the meter into the various buildings is up to you.

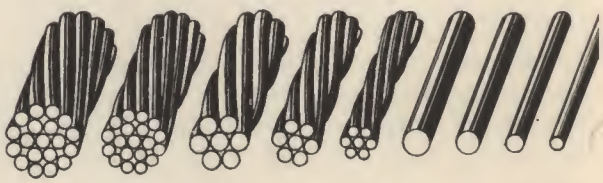
Number of feeder lines required. We recommend you use a separate 3-wire feeder from yardpole to each major building. This will permit later additions to the electrical load for each building without rewiring. However, in case of small outbuildings, for which you plan only lights or small-voltage appliances, it is perfectly acceptable to wire directly from one building to another instead of from the yardpole. Wires should be tapped on the outside of building, before they enter service entrance switch. See page 47.

Size of feeder wires. Wires must be heavy enough to carry the necessary amperage and must be strong enough to withstand ice, winds and weather. The Code specifies nothing lighter than No. 10 wire for runs up to 50 feet, nothing lighter than No. 8 for runs over 50 feet.

To determine the right size feeder wires to each building, you must know (1) the length of the run from yardpole to each building and (2) approximate wattage to be used in that building at any one time. (To find wattage, multiply amperage by voltage). Select feeder sizes from table at upper right.

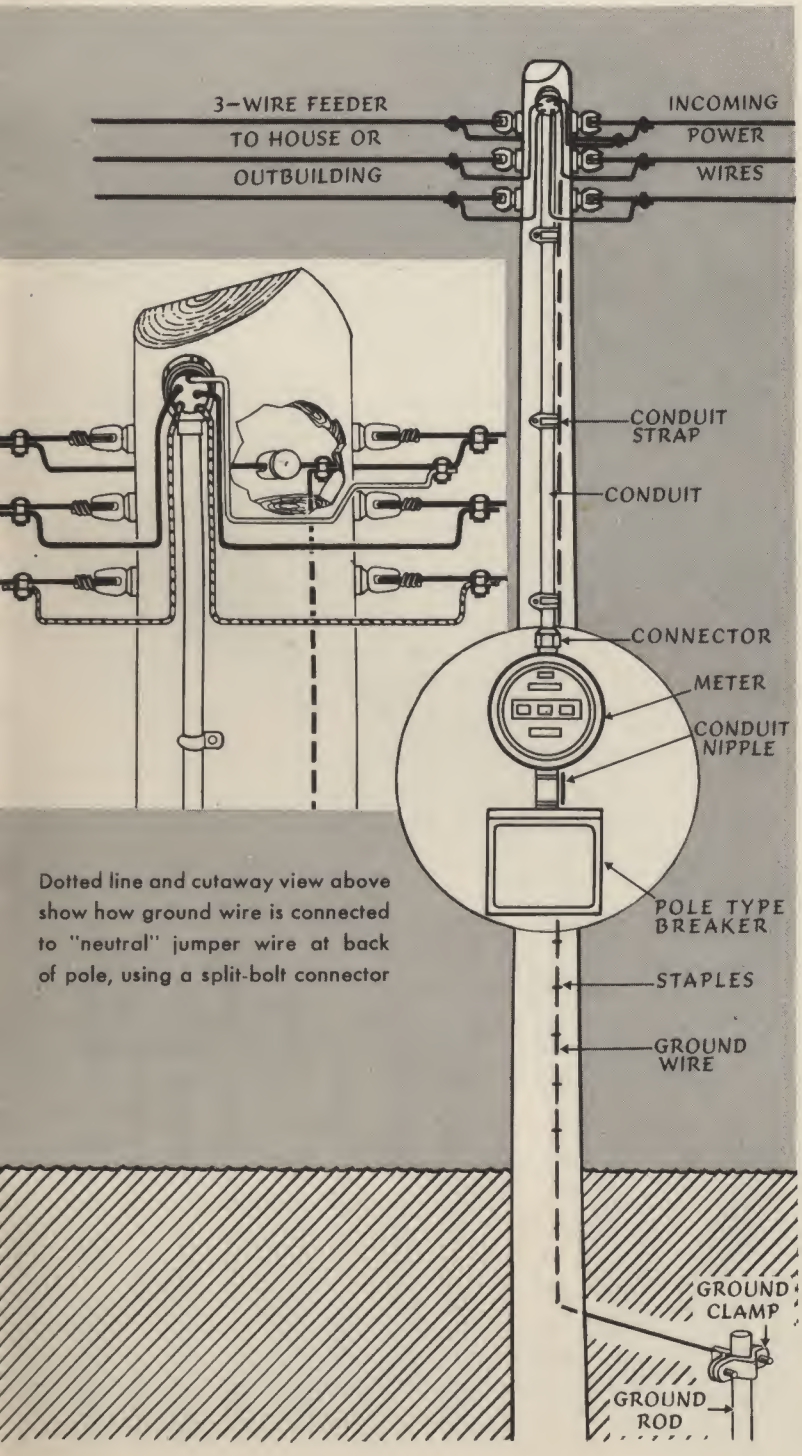
Operating demand of the building in watts	Distance in feet from pole to building	Size of feeder wire needed for the job
If the requirements are up to 3000 watts	Distance up to 50 feet	Use No. 10 wire
	Distance over 50 feet	Use No. 8 wire
If the requirements are 3000 to 5000 watts	Distance up to 50 feet	Use No. 10 wire
	Distance 50 to 125 feet	Use No. 8 wire
	Distance 125 to 250 feet	Use No. 6 wire
	Distance beyond 250 feet	Use No. 4 wire
If the requirements are from 5000 to 7000 watts	Distance up to 50 feet	Use No. 10 wire
	Distance 50 to 125 feet	Use No. 8 wire
	Distance 125 to 200 feet	Use No. 6 wire
	Distance 200 to 300 feet	Use No. 4 wire
	Distance beyond 300 feet	Use No. 2 wire
If the requirements are from 7000 to 9000 watts	Distance up to 50 feet	Use No. 10 wire
	Distance 50 to 100 feet	Use No. 8 wire
	Distance 100 to 150 feet	Use No. 6 wire
	Distance 150 to 250 feet	Use No. 4 wire
	Distance 250 to 350 feet	Use No. 2 wire
	Distance beyond 350 feet	Use No. 1 wire

Actual Wire Size of Copper Conductors Used in Electric Wiring.



Actual size of copper conductors. Note the larger the number the smaller the diameter of the wire.

to house, barn and outbuildings



Dotted line and cutaway view above show how ground wire is connected to "neutral" jumper wire at back of pole, using a split-bolt connector

Wiring the Yardpole

Two separate wiring systems meet at the Yardpole . . . [1] the power wires which bring in electricity from the Hi-line to the meter and [2] the feeder wires which distribute the metered electricity to the buildings. Illustrations at left show a system with a single 3-wire feeder, but additional feeders can be tapped in and mounted on the pole as needed. Note the connections for bringing the power wires into an entrance head on yardpole, then down through conduit to the meter and circuit breaker.

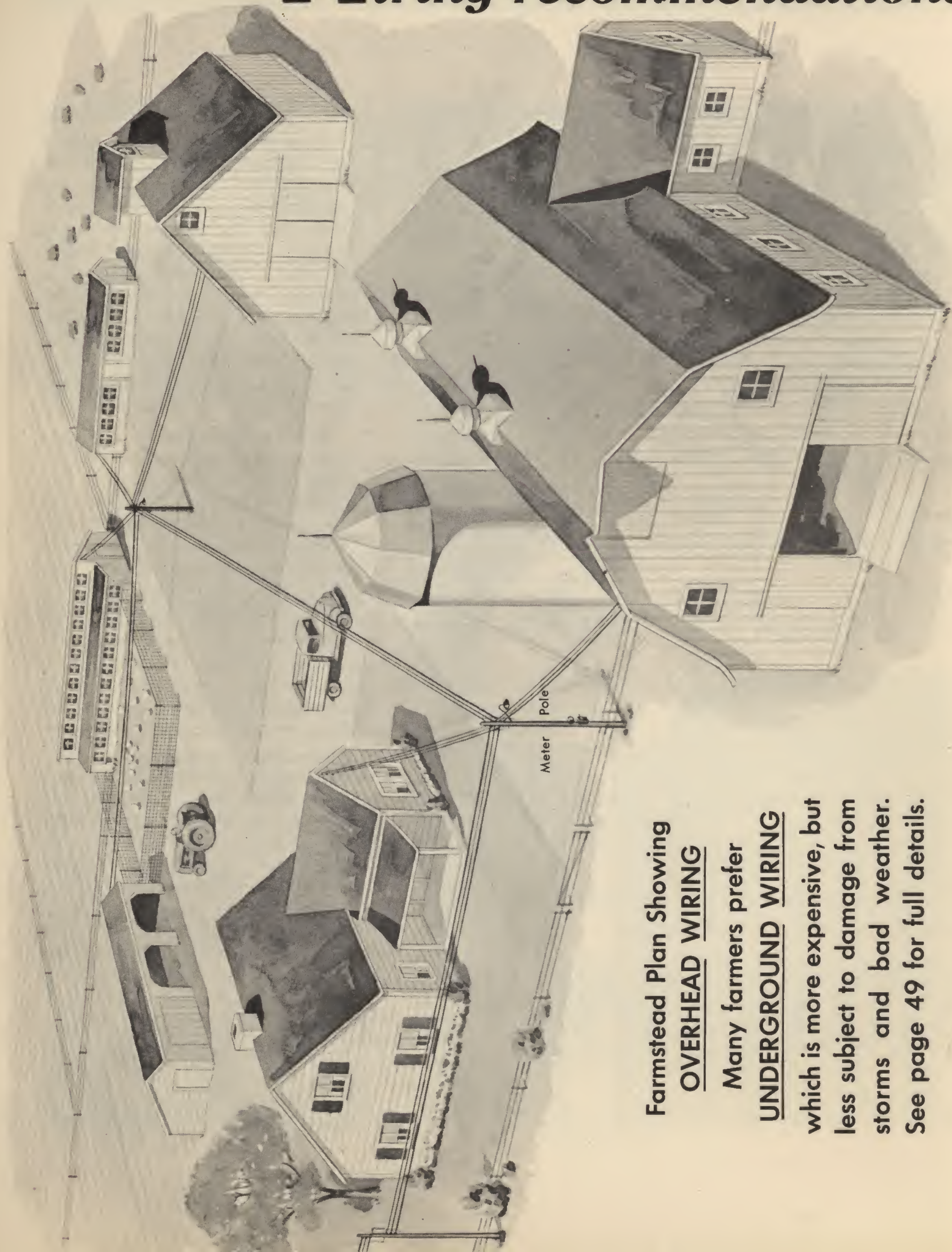
Wiring beyond the meter. Note how wires running up from the meter to the feeder wires are run through the same conduit as the incoming power wires and out the same entrance head. ***Exception***—Some localities will not permit the unmetered and metered wires to run in the same conduit. Check your local REA or Power Company for ruling.

Mounting feeder wires. Feeders to the various buildings must run so that they touch nothing except their insulating supports and must be at least 8 feet away from trees, roofs or other obstructions.

Grounding at yardpole. Grounded wire is shown as a dotted line in illustration at left. It should be connected at top of pole to the overhead "neutral" wire and then run down to the ground on side of pole that is opposite the meter. Grounded wire should be copper, no smaller than No. 6, and must be fastened every 6 inches through entire length of its run. Run wire in conduit or armored cover in cases where it might be subject to mechanical injury.

Ground rod should be non-ferrous type, not less than ½-in. diameter and 8 ft. long. Locate at least 24 inches away from yardpole. Top of rod must be driven at least 12 inches below soil.

Wiring recommendations



Farmstead Plan Showing
OVERHEAD WIRING

Many farmers prefer
UNDERGROUND WIRING
which is more expensive, but
less subject to damage from
storms and bad weather.
See page 49 for full details.

for your complete farmstead

Capacity of the Wiring System. In addition to having a Service Entrance of ample size (it used to be 60-amperes, now 100 amperes is often too small) an adequate farmstead wiring system should also provide all of the following conveniences:

(1) Enough Branch Circuits in all buildings to avoid too frequent use of long extension cords; ***(2) Special purpose 230-volt outlets*** for motor-driven equipment of ½ horsepower or over; ***(3) Enough duplex outlets*** conveniently located for smaller "plug-in" appliances, farm equipment and portable lamps; ***(4) Plenty of switch controlled lights*** where required for proper lighting, to reduce eyestrain, prevent accidents and increase efficiency; ***(5) Enough switches*** to control lighting of stairs, silos, mows, from above and below, always located at the latch side of each door to provide a path of light to and from each job; ***(6) Separate grounding*** of all permanently installed motors and other electrical equipment.

Size of Circuit Wires. Size 12 wire is recommended as the minimum size for all branch circuits. Experience shows that it is best to install large size wire on the farm. The difference in cost between smaller and larger wire sizes is relatively low, and installation charges are about the same in either case. Heavier wire provides the farmer with better service, assures greater safety, permits adding more equipment without overloading wires. In general, the size of the wire is determined by the length of the run, the electrical load to be carried and the maximum voltage drop permitted at the point of service.

Types of Installation. There are several ways of installing an adequate farm wiring distribution system. Wiring may be overhead or underground. The meter can be located on a pole or on the outside or inside of a building. However, the main service lines and the meter should be placed at a point as near as is practical to the electric load center of the farmstead. Feeder lines should be designed to hold voltage drops to a minimum, with particular emphasis placed on branch circuits serving brooders, incubators and similar equipment in which life processes are involved.

Distribution System Shown on Opposite Page is a typical pole metering installation, with the meter and transformer located on the same pole. Feeder lines radiate from the distribution pole to all structures on the farmstead. The electric pump is served directly from the meter pole. Note the position of wires in relation to the various buildings. None pass through or over any of the structures. This is recommended for delivery of uninterrupted power and to minimize the possibility of service being cut off by fire or accident in any of the buildings.

Outside Lighting. It is as necessary to light your way to the job as on the job. For that reason you need individual flood lights located at strategic corners of buildings or mounted on the main Yardpole as shown in illustration on opposite page. Lights should be installed so that they can be conveniently controlled from different locations. This can be done with Multiple-Control switches or with low-voltage Relay Control Systems.

Pressure Water Systems provide the farmer with water wherever he wants it and whenever he wants it. The electric pump should be supplied by a separate feeder and should be fused properly. This precaution keeps the system in "fire fighting trim" even after flames have destroyed buildings connected to other feeders. Use thermostatically-controlled heating cable at exposed points to protect the water system from freezing. Pump is usually located in basement of house for cold weather protection and easier servicing. (In Southern states, where winters are usually mild and many houses built without basements, electric pumps are often located above ground in protective structures.) Faucets should be located at various points about the farmstead. The uses of running water about the farm are many and vital. Although no attempt has been made to illustrate them in this booklet, their importance cannot be overemphasized.

Your Local REA Cooperative or Your Power Supplier will be glad to talk over your present and future wiring requirements and will suggest the type and size of wiring or equipment you will need.

Wiring Recommendation for

Feeder lines from the Yardpole are strung direct to dairy barn and a separate service entrance switch installed. Service entrance should not be less than 60 amperes so that devices requiring 230 volts can be operated without overloading circuits. A separate ground, in the form of a driven ground rod, should be installed.

A minimum of five circuits (as illustrated on opposite page), are recommended for the average size barn and milkhouse; two lighting circuits, two small appliance circuits, and at least one 230-volt circuit for motors and other heavy-duty equipment. If large fans or hay driers are to be used, install additional 230-volt circuits.

Non-metallic sheathed cable is used most frequently for barns and outbuildings. Review page 25 for instructions on wiring with non-metallic sheathed cable. Barn and outbuilding wiring is essentially the same as house wiring. However, a few more precautions should be taken. Always run cable along the sides of beams or joists, rather than along bottom. When cable runs crosswise to joists, studs or beams, run it through drilled holes rather than over surfaces, or protect it by running boards . . . the important point is to place cable where it will not be injured. Attach cable and fittings to studs, posts and interior parts of barn structure whenever possible because wiring will then be less affected by moisture and weather than when attached to exterior walls.

Use porcelain or bakelite fittings. Metal switch and outlet boxes can also be used, but are less satisfactory because they will eventually rust. Check your local requirements on this point.

Location of switches. Switches are not indicated in wiring diagram on opposite page, but they can be located wherever convenient. The preferred location for switches is next to the main doorway. Each row of lights should be on a separate switch. If barn has two entrances, it is a good idea to wire one row of lights with a 3-way switch at each entrance. Milkhouse light should be controlled from separate switch at its own doorway. All lights should be equipped with reflectors.

Location of lights and outlets. Plan lights so that they are spaced over aisles behind stalls every 12 feet. Convenience outlets and all switches should be located high enough so cattle cannot touch them. Place convenience outlets high on posts as shown, high on walls 15 feet apart, or suspended from ceiling on heavy-duty cords so that equipment such as clippers or milkers can be easily plugged in.

Wiring the hayloft. In hayloft, for extra protection against combustion and pitchforks, use rubber-covered wire in conduit. A switch, equipped with pilot light to show when light is "on", should be installed on ground floor. Only general illumination is needed so one or two lights are usually sufficient. Lights above hayline should be vapor-proof, dust-proof type to reduce danger of fire.

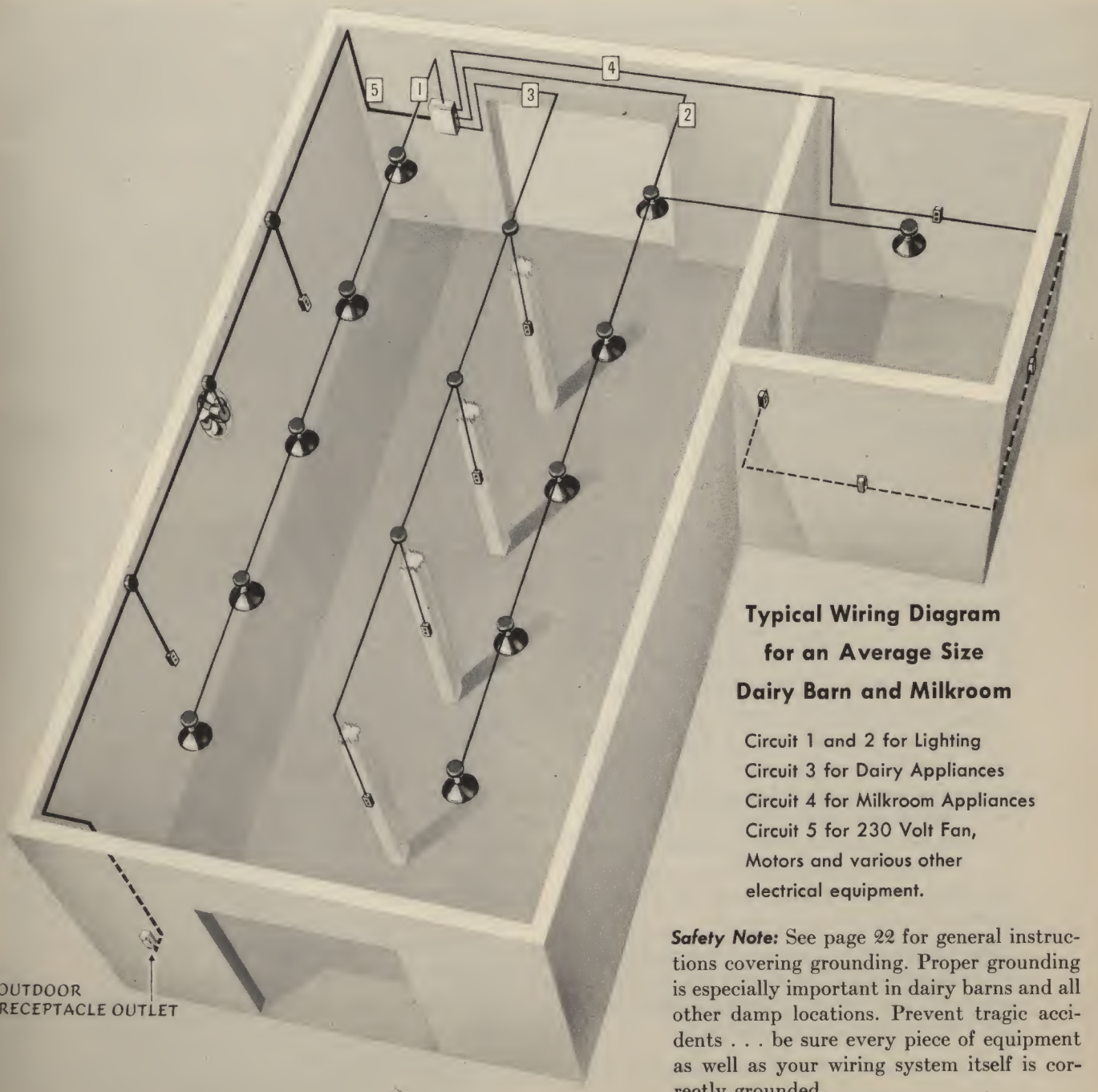
Wiring the milkhouse. Have at least one center light plus other lights if needed above work areas. Provide at least 3 convenience outlets for cream separator, bottle washer, small water heater, milk cooler, etc. Larger water heaters require a separate 230-volt circuit.

Wiring the silo. One or two of vapor-proof, dust-proof type lights at top of silo are sufficient to light chute and silo. Switch, equipped with pilot light to show when light is "on" should be located inside barn. Outlets for small portable motors should also be provided.

Ventilating fans and motors. Small fans or motors can be plugged into any outlet, but the larger high wattage fans and motors should be used only on a 3-wire, 230-volt circuit. To avoid overheated wires and voltage drop, this circuit should have wire heavy enough to carry the load of 2 or 3 heavy-duty appliances operating at the same time.

Outdoor receptacles. To facilitate using motors and other electric equipment out-of-doors, at least one weatherproof receptacle (or an ordinary receptacle covered by weatherproof housing) can be installed on the outside of building and should be connected to a 3-wire 230-volt circuit.

the Dairy Barn and Milkhouse

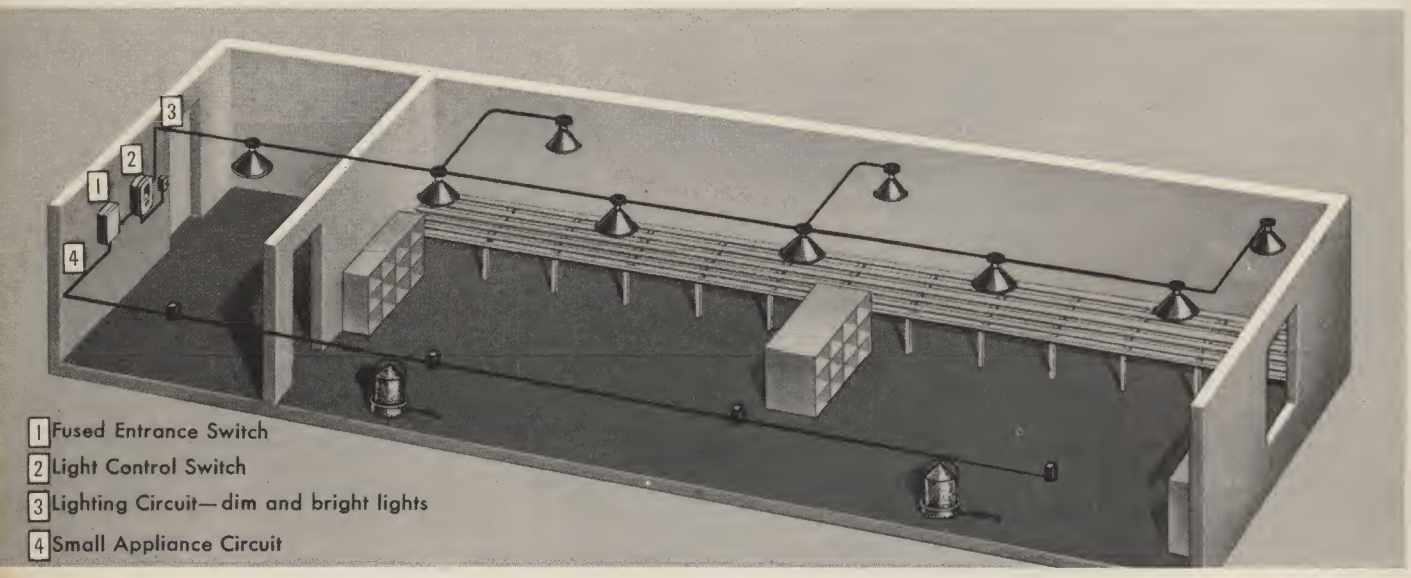


Typical Wiring Diagram for an Average Size Dairy Barn and Milkroom

Circuit 1 and 2 for Lighting
Circuit 3 for Dairy Appliances
Circuit 4 for Milkroom Appliances
Circuit 5 for 230 Volt Fan, Motors and various other electrical equipment.

Safety Note: See page 22 for general instructions covering grounding. Proper grounding is especially important in dairy barns and all other damp locations. Prevent tragic accidents . . . be sure every piece of equipment as well as your wiring system itself is correctly grounded.

Wiring the Poultry House



For the average-size poultry house we recommend a 3-wire service entrance wired from yardpole when possible. Size of entrance switch is determined by the size of building and number of appliances you intend to use. A 60-ampere entrance switch will deliver power for four or five 115-volt circuits plus one 230-volt circuit for feed mixer or grinder.

Lighting circuit. Lights should be placed at least 6 feet high and equipped with reflectors. You can increase egg production by use of a light control switch which increases light hours in which to lay. These switches are automatic and can be set for any schedule you want. Connect all lights to both a regular Hand Controlled switch and the Automatic light control switch so that lights can be turned on by hand when necessary.

Other circuits. Plan a separate circuit as illustrated above for small appliances such as water warmers or one electric brooder. Additional circuits will be required for the following:

One 115-volt circuit for each additional brooder.

One 115-volt circuit for each incubator.

One 115-volt circuit for germicidal or sun lamps.

One 230-volt circuit for Feed Mixer or Grinder.

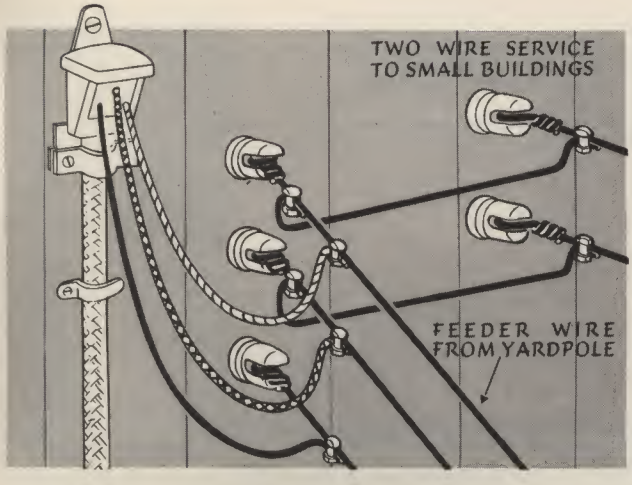
Non-metallic sheathed cable with bakelite or porcelain fittings is usually preferred for poultry houses and farm buildings because it stands up better in damp locations. See page 25 for instructions on wiring with non-metallic sheathed cable.

Workshop. 3-wire entrance recommended. For the best possible working conditions, have 2 types of lighting—general lighting controlled by a single-pole switch, and localized lighting over work areas, controlled by pull chains. Provide plenty of outlets including a 230-volt outlet for heavy motors and electric arc welder.

Hog house. 2-wire entrance is usually sufficient. Lighting outlets, controlled by a single-pole switch located near door, should be placed along every 20 feet of alleys. For pig brooders, convenience outlets are needed in the farrowing pens. Place about 3 feet above floor, in the corner of pen.

Sheep barn. 2-wire entrance is usually sufficient. A single row of lights, centrally located is all that is necessary in barns 30 to 32 feet wide. In larger barns install 2 or more rows of lights. Provide outlets for lamb brooders and extension cords. Arrange to have the lights controlled by single-pole switch near the door for convenience.

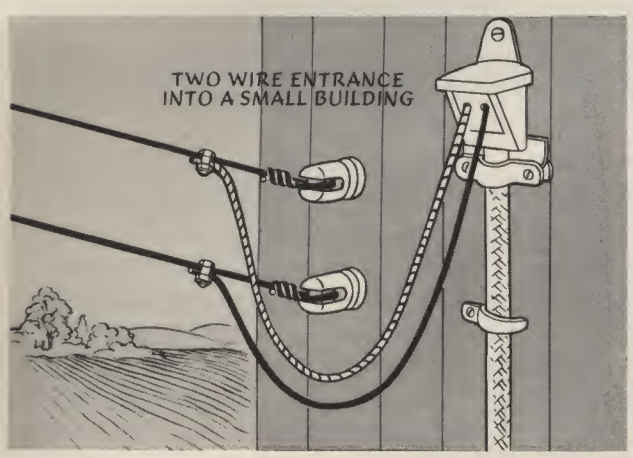
Two wire Service to outbuildings



Tapping 2-wire from 3-wire service

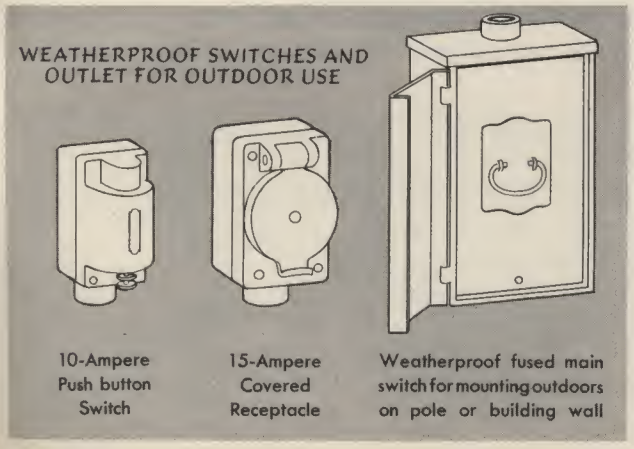
Method shown at left is used ***only for systems wired from a yardpole.*** (See page 48 for 2-wire entrance with systems which do not have yardpole.)

Two-wire service should be planned only to outbuildings requiring a load of less than 3400 watts and using motors of ½ HP or less. The 2-wire lines may be run direct from the yardpole but usually it is easier to tap off wires running from yardpole to a neighboring building, provided those wires are heavy enough to carry the increased load. This method makes it unnecessary to wire through entrance switch of neighboring building. Usually the system is grounded at each building.



Two-wire service entrance

Regular weather-proof wire is used—8-gauge is recommended to withstand the strain of ice and wind. Insulators on buildings should be placed so that wires are at least 12 inches apart, and have a clearance from the ground of at least 18 feet over driveways; 10 feet over foot walks. Use either conduit or service entrance cable on the vertical run. Method of installing a 2-wire entrance is essentially the same as outlined on pages 20 and 21 except that 2-wire cable and a smaller entrance switch will be used. A 30-ampere 115-volt entrance switch is usually used, protected with fuses no larger than capacity of smallest wire.



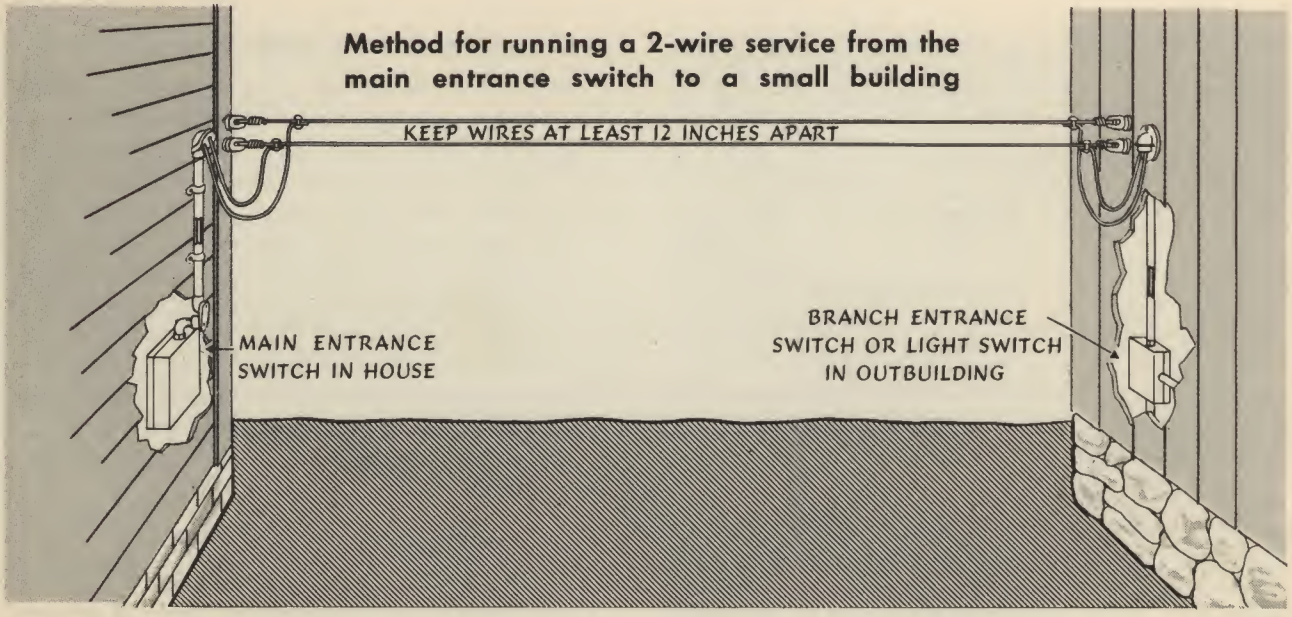
Outdoor Switches and Receptacles

To use electrical equipment in damp locations and out-of-doors, weather-proof devices must be installed where motors and high-wattage farm equipment can be conveniently plugged into them.

Outdoor Switches and Receptacles vary in size. A 15-ampere receptacle is large enough for most jobs but if a large motor (½ H. P. or over) is to be used, heavier switches and receptacles are needed and they must be installed on a 3-wire 230-volt circuit. When wiring receptacles, connect black or red wires to the dark-color terminal, and the white wire to light-color terminal. If wires run underground the same rules apply as stated on page 49.

PART 5

Overhead Wiring

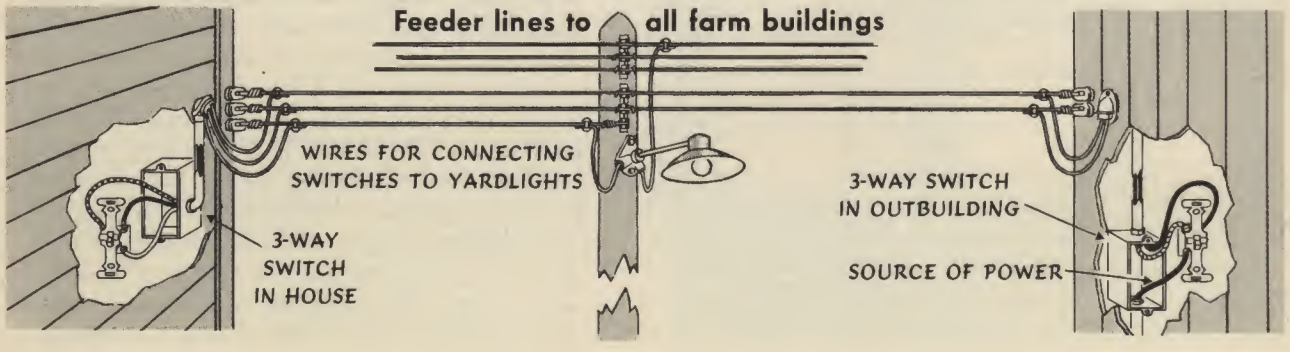


Method above is recommended only when garage or outbuilding will require a very small electrical load. It cannot be used with systems wired from a yardpole. (See page 47 for 2-wire entrance for yardpole systems.)

Installation. Use 10-gauge weather-proof wire for overhead runs under 50 feet (8-gauge over 50 feet) and conduit or service entrance cable for vertical runs into buildings. Loops are made from entrance heads to insulated brackets at least 15 feet above ground. See pages 20,21 for instructions on service entrance wiring.

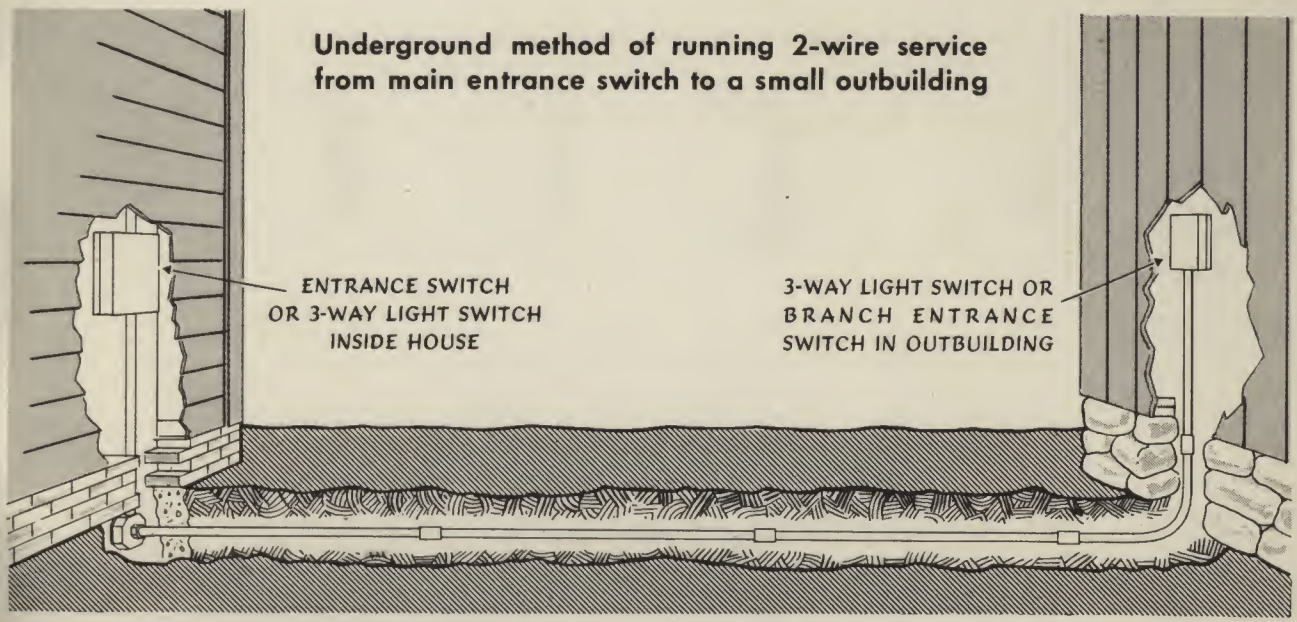
Wiring within the outbuilding is determined by amount of electricity that will be required. A simple toggle switch is usually enough for a few lights and receptacles . . . but a special entrance switch must be installed whenever branch circuits are required.

Mounting yardlight on yardpole. This is a necessity for every farm . . . it spreads visibility at night and helps to prevent accidents. Assuming that barn is already wired and using the installation shown below, the yardlight may be turned on or shut off from either the house or the barn. Regular 3-way switches are used. (See page 15.) Note that in hook-up below, there are three wires leading from the house to the yardlight at the yardpole, and only two wires from the light to the barn. This method saves a length of wire by simply tapping the "neutral" off feeder wire on the yardpole.



PART 6

Underground Wiring

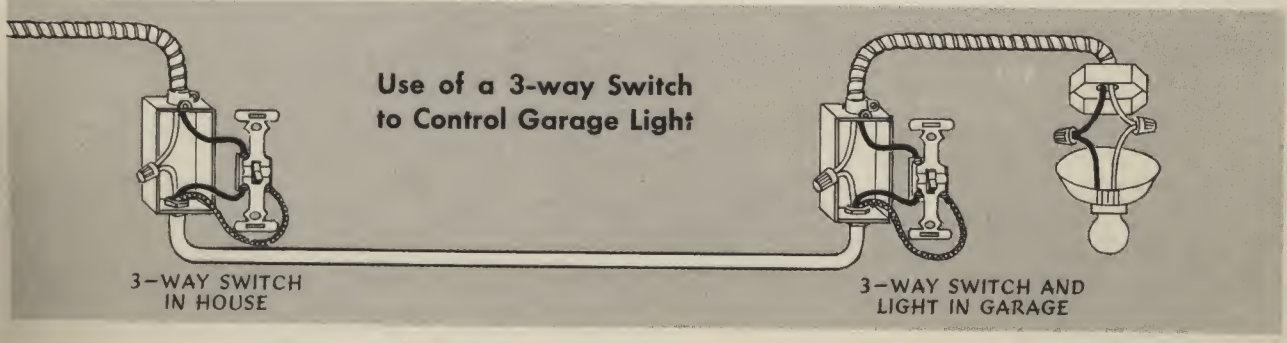


Underground method of running 2-wire service from main entrance switch to a small outbuilding

Underground wiring is usually used to garages, barns, outbuildings, or wherever overhead wires would be in the way or would detract from the appearance of the property. The most common type of underground wiring is lead-covered cable enclosed in conduit—two or more insulated wires encased in a lead sheath, then pulled through metal conduit. Use ¾-inch conduit for 2-wire lead cable (No. 10, 12, or 14 wires) . . . use 1-inch conduit for 3-conductor cable. Lead-covered cable is not very flexible, so avoid sharp bends in conduit. Bury conduit 18 to 24 inches, or below the frost line to prevent heaving and condensation. Do not bury in cinders.

Installation is made as shown above. Wires can be tapped off by way of a junction box at any point of a run inside the house. Wall must be sealed where conduit enters building with a suitable compound for protection from rain water entering building.

Garage wiring usually calls for only a receptacle and a light or two to be controlled independently by 3-way switches located in house and garage (see diagram below). If, however, you want a much larger load, a special entrance switch, usually 30-ampere size, will be required within garage or outbuilding, and you must be sure that the main entrance switch in house is large enough to carry the increased load.

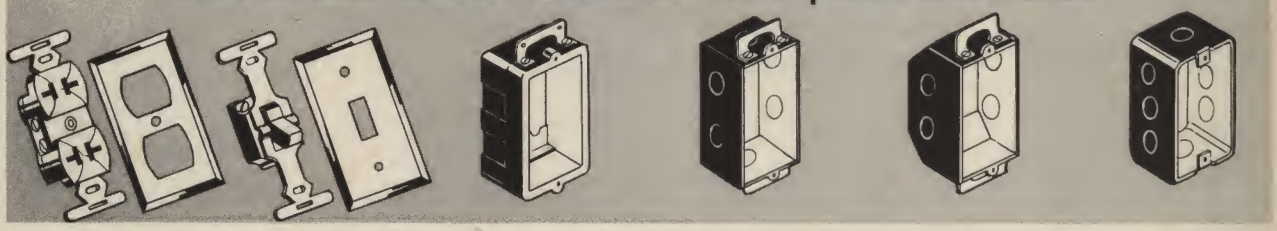


Use of a 3-way Switch to Control Garage Light

PART 7

Basic wiring devices

Convenience outlets . . switches . . wall plates and boxes



Bakelite Duplex Wall Outlet and Plate. Fits any standard flush or surface-mounted switch box. Mounting bracket for aligning with wall surface

Bakelite Toggle Switch and Plate. Fits any standard flush-or-surface-mounted switch box. Easy to wire and mount. Choice of single-pole or 3-way types

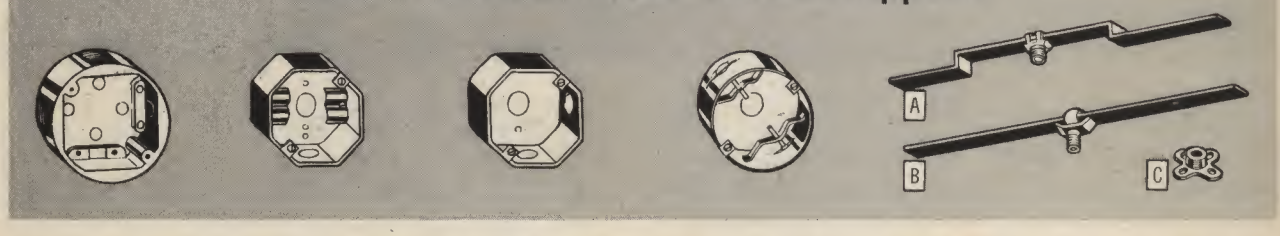
Bakelite Outlet or Switch Boxes are for use in basement, barns, laundries and damp locations. For non-metallic sheathed cable only. Equipped with clamps

Steel Outlet or Switch Boxes are recommended for use in house and in dry locations. Use with non-metallic or armored cable. With or without clamps

Beveled-corner Boxes are used for easy fitting into wall openings in old buildings. Clamps for loom or non-metallic sheathed cable. No connectors needed

Surface-mounted Utility Boxes. Screw to wall surface in exposed wiring. Use with armored or non-metallic sheathed cable. Use Bakelite for damp locations

Outlet . . Junction boxes and box supports



Bakelite Octagon Outlet Box. Use as junction box or for lighting outlets in damp locations. Clamps for non-metallic cable; no connectors needed

Steel Octagon Box with Clamps. No connectors are needed. Use for drop-cord outlets, fixture outlets or as junction box in house or other dry locations

Octagon Box without Clamps. Same as left except that separate connectors are required. Use with armored or non-metallic cable, or conduit

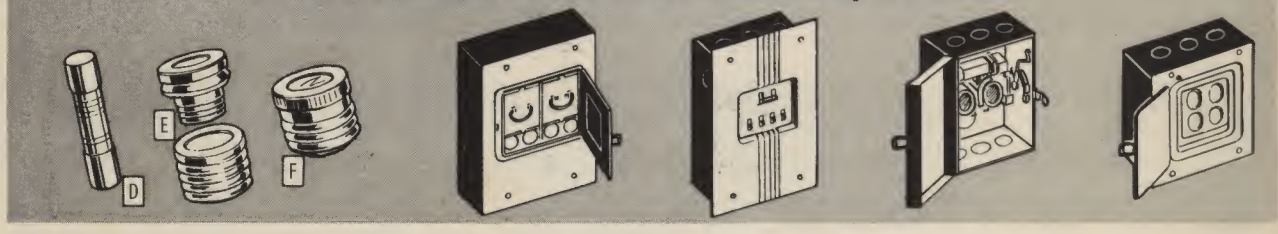
Shallow Ceiling Box. With cable clamps. Use with straight bar hanger for flush mounting. For "old" work where deeper box would protrude below ceiling

Offset Bar Hanger [A] is used to mount outlet box flush with ceiling in "new" work, or level with the joists in barns, basements, attics. Has sliding stud

Straight Bar Hanger [B]. For mounting shallow box in "old" work

Fixture Stud [C]. For hanging fixtures direct to outlet box

Fuses . . Fustats . . Entrance and safety switches



Fuses are "safety valves" which protect against overloads. Amperage of fuse should correspond to amperage of circuit. **Cartridge fuses** [D] come in 15 to 60 amp. size. **Plug fuses** [F] in 15 to 30 amp. **A Fustat** [E] (used with adapter which fits into regular fuse sockets) is a tamper-proof fuse with time lag . . . takes temporary overloads without blowing

Fused Entrance Switch. Uses cartridge and plug fuses to provide protection for main service, range circuit and branch lighting and appliance circuits. 60 to 150-ampere size

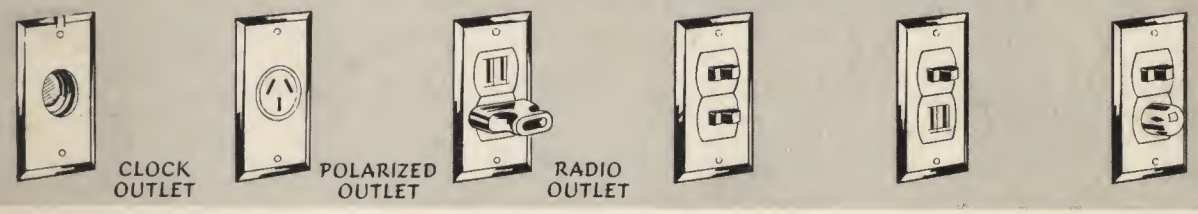
Westinghouse "No-Fuse" Entrance Switch. Current automatically shuts off when overloads occur. Flip handle to restore current after fault is corrected. (No fuses needed)

Fused Indoor Safety Switch. Use as entrance switch for small buildings, or to provide protection for water heaters, motors. 30 amp., 2- or 3-wire, 110 to 250 volt

Surface Mounted Fuse Cabinet. Use with safety switch such as the one shown at left, wherever additional branch circuits are required from the main line

and how they are used

Special purpose switches and receptacle outlets



Clock Outlet with Hanger. Fits switch box. Receptacle is recessed so that it holds both plug and wire . . . permitting clock to hang flush with wall

3-wire Polarized Outlet for use indoors. Has 3 connections, two for power wires, one for grounding the metal frame of laundry or dairy appliances

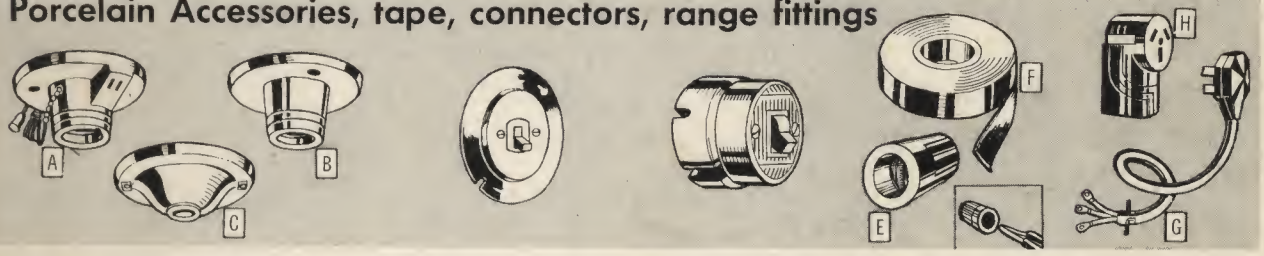
Radio and Power Outlet. Eliminates long runs of exposed wire. Plug-in connection for aerial and ground . . . also a power outlet for operating radio

"2-in-1" Toggle Switch. Operates lights in two separate locations, doubling the usefulness of any standard switch box. Easy to mount. No special tools needed

Toggle Switch and Outlet. Fits switch box; offers a convenience outlet and light switch all in one. Can be wired so outlet operates independently of switch

Switch with Pilot light. Warns when current is "on." Handy in cases where bulbs operated by switch are not visible from where they are switched off and on

Porcelain Accessories, tape, connectors, range fittings



Porcelain Sockets and Outlet Receptacles can be used in damp as well as dry locations. Type [A] provides both an appliance outlet and a pull switch. Type [B] is for connection to outlet boxes controlled by a wall switch. Type [C] is simply a Drop Cord Cover used to suspend sockets on cords from ceiling outlets

Round metal covered Toggle Switch. Single-pole. Fits compactly over round or octagon boxes on opposite page. Used for either surface or flush mounting

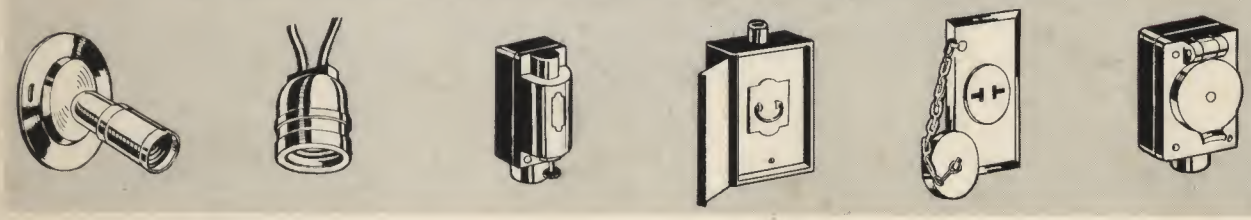
Surface mounted Bakelite Switch. Use single-pole type to control a light from one point; use two three-way types to control a light from two points

Solderless Connectors [E] connect wires without tape or solder

Rubber Insulating Tape [F] is used over bare wires. Cover with friction tape

Range Cable [G] and **Receptacle** [H]. More convenient than a permanent installation . . . range can be disconnected. Receptacle connects from entrance switch

Special sockets . . Weatherproof switches and receptacles



Swivel Fixture for holding spot or floodlight bulbs. Use to direct light wherever you want it—outdoors for picnics or games—inside for display purposes

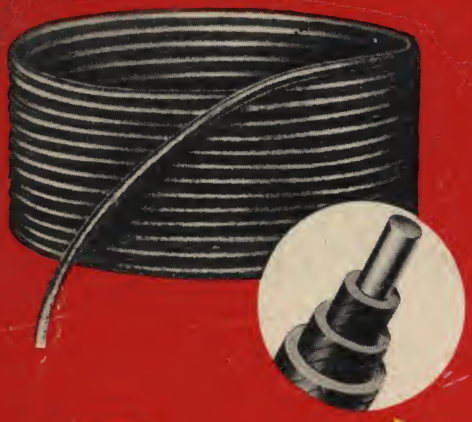
Weatherproof Insulated Socket. Long-lasting, weather-resistant, for heavy-duty outdoor use. Handy for plugging in appliances or for extra light outdoors

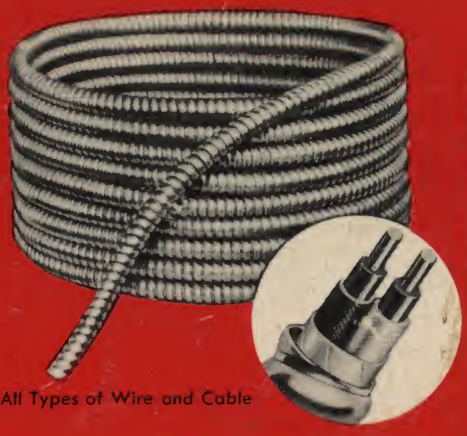
Outdoor Weatherproof Switch used to control electric lights from damp locations and out-of-doors. Single-pole, plunger operated, 10 amperes, 125 volts

Heavy-duty outdoor weatherproof Entrance Switch for handling large service loads and heavy-duty appliances. 125-250 volts 60 amps. 3-wire solid neutral. Uses 2 pull-type fuses

Flush-mounted Weatherproof Outlet, controlled by switch inside building. Used for decorative lighting, temporary yardlights, any outdoor installation

Outdoor Weatherproof Receptacle in iron housing; waterproof hinge cover. Install outside barns, garages or where motors are to be used. 15 amps. 125 volts





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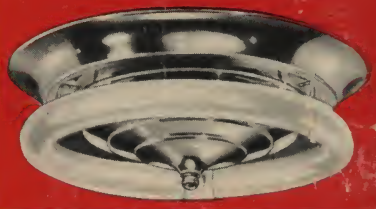


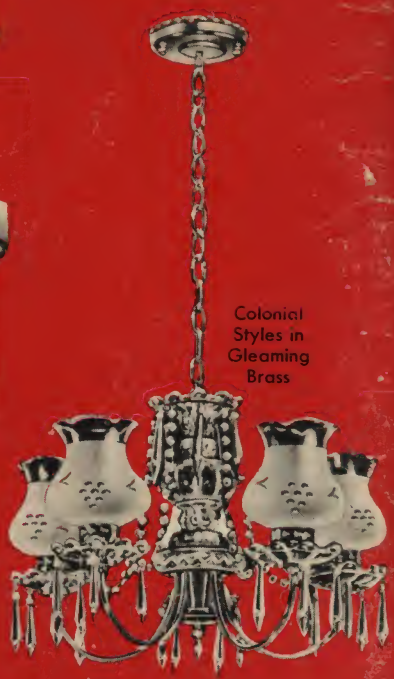
Circline Fluorescents

Strip Lights

Ceiling Fixtures

Kitchen Fluorescents

All Types of Dining and Living Room Fixtures



Colonial Styles in Gleaming Brass